INSTRUCTION MANUAL

for

PANORAMIC PANALYZOR

MODEL SB-8b

TYPES T-200 & T-1000

Panoramic INSTRUMENTS

Manufactured by

SINGER METRICS DIVISION

THE SINGER MANUFACTURING COMPANY

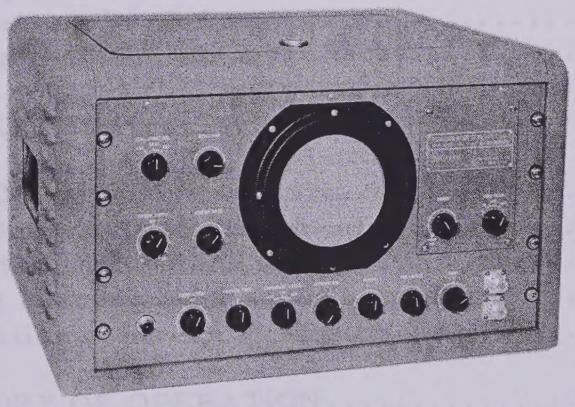
915 PEMBROKE STREET • BRIDGEPORT 8, CONNECTICUT

INSTRUCTION MANUAL
for

PANORAMIC PANALYZOR

MODEL SB-8b

TYPES T-200 & T-1000



PANORAMIC RADIO PRODUCTS, INC.
520 South Fulton Avenue, Mount Vernon, N.Y. • Phone: OWens 9-4600

INSTRUCTION MANUAL

for

PANORAMIC PANALYZER

MODEL SPA-3B

TYPE 1138-A FIGURE

PANORAMIC RADIO PRODUCTS, INC.
520 South Fulton Avenue, Mount Vernon, N.Y. • Mount Vernon 4-2600

TABLE OF CONTENTS

		Page
CHAPTER I - INTRODUCTION		1
I-1.	General	1
I-2.	Applications	1
I-3.	Equipment Supplied	2
I-4.	General Description	2
I-5.	Electrical Characteristics	5
I-6.	Physical Characteristics	6
I-7.	Operating Controls	7
I-8.	Tube Complement	10
I-9.	Terms and Definitions	10
CHAPTER II - INSTALLATION		15
II-1.	Initial Inspection	15
II-2.	Interconnecting Procedure	15
II-3.	Installation Adjustments and Checks	17
CHAPTER III - OPERATION		27
III-1.	General Operation	27
III-2.	Relative Amplitude Measurements	30
III-3.	Narrow-Band Analysis	31
III-4.	Operating Procedure for Pulsed Signals	36
III-5.	Interpretation of Screen Presentations	37
CHAPTER IV - THEORY OF OPERATION		41
IV-1.	Introduction	41
IV-2.	Circuit Description	42
CHAPTER V - SERVICE AND MAINTENANCE		53
V-1.	Semi-Adjustable Controls	53
V-2.	Trouble Shooting	55
V-3.	Voltage and Resistance Charts	62
V-4.	Alignment Procedure	66
V-5.	List of Replaceable Parts	79

LIST OF ILLUSTRATIONS

Figure	Illustration	Page
I-1.	Presentation of Radio-Frequency Spectrums	4
I-2.	Front Panel, Model SB-8bY, Type T-200	13
I-3.	Front Panel, Model SB-8bZ, Type T-1,000	14
II-1.	Interconnecting Diagram	16
II-2.	Outline Dimensional Drawing, Model SB-8bY, Rack Mount Style	21
II-3.	Outline Dimensional Drawing, Model SB-8bZ, in Cabinet	22
II-4.	Outline Dimensional Drawing, Model PS-8b, Rack Mount Style	23
II-5.	Outline Dimensional Drawing, Model PS-8b, in Cabinet	24
II-6.	Outline Dimensional Drawing, Constant-Voltage Transformer	25
III-1.	Resolution (KC) vs Sweep Width (KC) Type T-200	32
III-2.	Resolution (KC) vs Sweep Width (KC) Type T-1,000	32
III-3.	Minimum Frequency Separation Required to Measure Amplitude Ratios E_2/E_1, Type T-200	34
III-4.	Minimum Frequency Separation Required to Measure Amplitude Ratios E_2/E_1, Type T-1,000	34
III-5.	Ringing as an Indication of Optimum Resolution	35
III-6.	Appearance of Typical Panoramic Indications	39
IV-1.	Block Diagram, Model SB-8b	40
IV-2.	Overall Response of Panalyzor	43
IV-3.	Relationship of R-f Bandpass and Oscillator Sweep Frequencies to Input Signals	45
IV-4.	A. Representation of Resolution	46
	B. Ringing Effect Indicating Optimum Resolution	46
V-1.	Crystal Rejection Slot Removal	69

CHAPTER I - INTRODUCTION

I-1. GENERAL

This Instruction Manual has been prepared to assist in the installation, operation and maintenance of the following equipments:

Panalyzor, Model SB-8b, Type T-200
Panalyzor, Model SB-8b, Type T-1,000

No attempt to operate the equipment should be made until the operator is thoroughly familiar with the information contained in CHAPTER III - OPERATION.

I-2. APPLICATIONS

The uses detailed below represent but a few of the many applications of the Panalyzor. Inquiries are invited regarding the application of these instruments to particular requirements.

The Panalyzor offers visual means of examining oscillator performance, especially in the VHF regions where small changes in circuit constants, both physical and electrical, produce large frequency variations. Oscillators can be checked against standards for determining frequency and the effects of load changes, component variations, shock, and humidity and thermal changes upon frequency stability. Parasitic oscillations are easily spotted and identified.

Diathermy units, dielectric and induction heaters, and other industrial r-f equipments can be analyzed and monitored within close tolerances for off-frequency operation with the Panalyzor. Either two separate crystal controlled oscillators or a single modulated crystal oscillator may be used as standards to produce marker pips which indicate the permissible frequency limits of operation.

The Panalyzor shows the static and dynamic operating characteristics of f-m sources pictorially. Frequency modulated signals are seen as a carrier flanked by the Bessel function sidebands. F-m static deviations may be calculated by noting the zero amplitude levels of either the carrier or adjacent sidebands. Modulated signal displays are useful for measuring energy distribution and for looking for such effects as unwanted or excessive modulations, linearity of deviations, hum and noise, and otherwise undetectable parasitic oscillations.

Piezo-electric crystal blanks, and crystals in the process of being ground, can be compared against a standard for frequency and activity. Horizontal displacement of the deflection of the test crystal from the standard deflection indicates the direction and magnitude of frequency difference.

Small differences in frequency may be made more prominent by reducing the sweep width. Thus tedious frequency checks by heterodyne beating are eliminated.

I-3. EQUIPMENT SUPPLIED

Information for identification of equipments described in this Manual is contained on the front panel of the analyzer section.

The following units constitute a complete equipment:

Description	Quantity per Equipment
Analyzer Section	1
PS-8b, Power Supply	1
Constant-Voltage Transformer #T3016-1	1
Interconnecting Power Cable	1
Prefabricated R-F Cable	2

I-4. GENERAL DESCRIPTION

The Panalyzor is an automatic scanning receiver which permits visual analysis and identification of one or many radio-frequency signals at one time. Each signal within the band being scanned is displayed on a cathode-ray tube screen as a pip or a group of pips depending upon the nature of the signal. The "pip" amplitude and position along the calibrated horizontal axis are indicative of signal level and frequency, respectively.

The sweep width or the extent of the band display above and below a given frequency which appears at the center of the screen, is continuously adjustable from maximum to "zero". The Type designation of the equipment indicates the maximum sweep width.

Type	Maximum Sweep Width
T-200	±100 KC
T-1,000	±500 KC

The Panalyzor is designed to operate with an external oscillator or signal generator to "tune in" a given spectrum segment. The signal generator is connected to one of the two input r-f connectors. The signal or signals to be examined are coupled directly from their source through a coaxial cable to the other input connector.

The input stage of the Panalyzor is an aperiodic mixer which, in conjunction with the external oscillator, is equivalent to the frequency converter of a superheterodyne receiver.

A signal will cause a deflection of the crt beam at the center of the screen when the generator is set at a frequency equal to the signal frequency ± the Panalyzor input center frequency. (Refer to ELECTRICAL CHARACTERISTICS, Paragraph I-5.)

The Panalyzor may be used as described above to examine signals up to 1000 MC. Higher frequencies may be investigated by effecting conversion with a suitable mixer attached to either of the input r-f connectors. The flatness of response of the Panalyzor is dependent primarily upon the bandpass characteristic of the instrument. The accuracy of the amplitude indication is therefore fixed within the limits specified.

Images are not suppressed since the Panalyzor utilizes an aperiodic mixer (without any preselection). For example, if it is desired to examine a 100 MC signal with a Type T-1,000 Panalyzor, the external oscillator would be set at 105 MC, the input center frequency being 5 MC and the bandpass from 4.5 MC to 5.5 MC. A signal of 110.1 MC which may be present would also be heterodyned down to 5.1 MC to produce an image. Both the 100 MC and 110.1 MC signals would be equally acceptable to the aperiodic mixer.

Images, however, can be identified rapidly and simply since the image deflections move in a direction opposite to that of regular signals as the external oscillator is tuned.

The Panalyzor provides a visual presentation of a portion of the radio frequency spectrum on a two dimensional surface.

Frequencies are shown on the horizontal axis of the screen (base line).

Signal Amplitudes are indicated on the vertical axis. This is illustrated in Figure I-1.

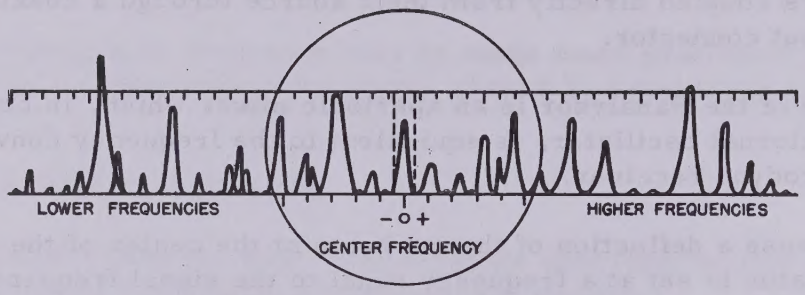


Figure I-1. Presentation of Radio Frequency Spectrum

The entire strip represents a portion of the r-f spectrum. The circle represents the range visible on the screen. The section directly over the zero (0) on the scale corresponds to a signal heterodyned down to the input center frequency of the Panalyzor. Each signal produces its own pip or group of pips which help identify or analyze the signal.

First: The pips indicate frequencies of signals with respect to a signal at the center of the screen. The horizontal axis of the screen is divided into ten parts. At maximum sweep width each dividing marker represents a 20 KC separation for the T-200 and 100 KC for the T-1000. The frequency of the centered signal may be determined from the external oscillator dial.

Second: Information on the relative levels of the signals is also given on the screen. The height of each signal peak varies proportionately with signal strength. Signal amplitudes are indicated either linearly, logarithmically or exponentially. Amplitude scale selection is made with a front panel control. The linear amplitude range is 10:1. The log range is 40 db. The exponential range is 10 db.

Third: The deflections also reveal the character of the signal and the type of modulation, whether c-w, phone or pulse, etc. The feature of Variable Resolution enables examination of signals so closely adjacent in frequency that their corresponding deflections

normally tend to merge together or even completely mask one another in wide scan displays. This is of particular value in observing sidebands caused by low frequency audio modulation.

I-5. ELECTRICAL CHARACTERISTICS

Types	T-200	T-1000
Maximum Sweep Width	200 KC	1000 KC
Input Center Frequency	500 KC	5 MC
Bandpass Region	400 KC to 600 KC	4.5 MC to 5.5 MC
Bandpass Region Characteristic: Flat to	±5%	±7%
Resolution:	See Fig. III-1	See Fig. III-2
Image Rejection Ratio at Input Center Frequency: Better than:	250:1	150:1
Spurious Response above the Bandpass: No signal exclusive of images, of a frequency above the bandpass and less than .1V will produce a deflection greater than:	40 db below input signal	40 db below input signal
Spurious Response within the Bandpass: Input signals within the bandpass may result in spurious indications greater than 40 db below the input signals if the input signal exceeds:	20,000 uV	.1V
Direct Sensitivity: Maximum voltage at center frequency required for full scale deflection on linear amplitude scale:	100 uV	500 uV

Types	T-200	T-1000
Product Sensitivity: Maximum product voltage of external oscillator voltage X test signal voltage required for full scale deflection on log amplitude scale. Neither the generator output nor signal should exceed .1 Volt.	10^{-3} V-V	5×10^{-3} V-V
I-f Transformer Tuned to:	226 KC	1.5 MC
F-m Oscillator Mean Frequency:	726 KC	6.5 MC
Input Impedance	50 ohms	50 ohms
Sweep Rate and Wave Form:	1 to 60 cps sawtooth, variable, free running, line or externally synchronized.	
External Sync Amplitude	1 volt (nominal)	
Power Source:	115 VAC, 60 cps, single phase	
Power Consumption with CV Transformer (Approx.)	135 Watts, 160 VA	

I-6. PHYSICAL CHARACTERISTICS

a. Weights

Description	Weight
Analyzer Section	27 lb
Power Supply, PS-8b	33 lb
Constant-Voltage Transformer	20 lb
Cabinet, Analyzer Section	28 lb
Cabinet, Power Supply	12 lb
Cables	3 lb

b. Dimensions

See Outline Dimensional Drawings, Figure II-2 through II-6 for complete dimensional data.

I-7. OPERATING CONTROLS

The following controls are at the disposal of the operator. They are mounted on the front panel.

a. CAL-SYNC SEL: This control is a three position switch. In the CAL position it provides for calibration of the sweep rate by injecting 60 cps into the vertical deflection. In the LINE position, the sweep is synchronized with the power line frequency. The EXT position permits sweep synchronism with a suitable signal fed to the EXT SYNC jack on the rear apron of the analyzer section chassis.

b. SYNC AMP: The amplitude of the sweep synchronizing signal is adjusted with this control to provide for crt beam sweep synchronism. Maximum amplitude is obtained at maximum clockwise position.

c. SWEEP WIDTH: The width of the spectrum segment being scanned by the instrument is adjusted with this control. When it is turned completely clockwise, the maximum spectrum width for which the instrument is designed can be seen on the screen. As the control is backed off in a counterclockwise direction, the bandwidth viewed becomes narrower. The part which can be seen, however, is expanded across the screen and hence is virtually magnified.

   This control, in conjunction with the RESOLUTION control, is useful for separating two or more signal deflections which are so close as to merge into each other.

   The panel calibration markings below maximum are only approximations and should be considered as such.

d. SWEEP RATE: This control provides for continuously adjustable scanning rates between 1 cps and 60 cps. Counterclockwise rotation results in reduced scan rate.

e. DIMMER: This control is rotated in a clockwise direction to turn on the power. When the crt is a 5ADP7, continued clockwise rotation of this control reduces the brightness of the edge lighting of the crt calibrated screen. When a 5UP7 is used, this control dims the pilot light. The switch does not control the power line input to the constant-voltage transformer.

f. VIDEO FILTER: This three-position switch provides two degrees of video filtering to suppress such unwanted effects as noise, spurious beating between adjacent signals, hum, etc. The signal pips will be integrated and shifted slightly when the filter is in. An OUT position is provided.

g. RESOLUTION: Resolution, or the ability to separate individual signals, is dependent upon two factors: the rate of frequency scan and the bandwidth of the i-f section of the instrument. Optimum resolution requires a definite relationship between the two. Resolution sharpens as both the frequency-scanning rate and i-f bandwidth are decreased.

The RESOLUTION control is used to narrow the i-f bandwidth. Counterclockwise rotation decreases the bandwidth of the second i-f section. It should be noted that as this control is adjusted, there will be some degree of change in the sensitivity of the equipment.

The frequency scanning-rate is diminished by increasing the scanning period or conversely by decreasing the spectrum width scanned within a given time.

The SWEEP WIDTH control provides the latter method. For a given setting of the SWEEP WIDTH control there is a complementary setting of the RESOLUTION control to obtain optimum resolution. (See Paragraph IV-2e for a detailed discussion of resolution.)

h. CENTER FREQ: This control serves to restore or maintain the f-m local oscillator at its specified mean frequency. In this way, the deflection corresponding to a signal at the input center frequency is centered on the crt screen. Flatness of response is dependent upon this control.

i. AMPLITUDE SCALE: Selection of linear, logarithmic or exponential amplitude presentations is accomplished with this three-position rotary switch.

In the LOG position, signals having a 40 db (100:1) amplitude ratio can be viewed on the screen. In this switch position, the calibration dots on the left side of the screen are used. The calibration range is from -20 db to +20 db in 5 db steps.

In the LIN position, signals having a 20 db (10:1) amplitude ratio can be viewed on the screen. In this switch position, the horizontal calibration lines on the crt screen are used. The linear scale is calibrated in ten divisions.

In the EXP position, the pip height varies as the square of the signal voltage for an approximate range of 4:1.

It should be noted that because of the time constant factor, the LOG feature does not function properly with narrow pulses. Because of ac coupling in the circuit the EXP feature functions properly only with narrow pips and/or fast scan rates.

j. INTENSIFIER: To observe pulsed or noise signals, this control is turned in a clockwise direction. Noise and pulse signals will then intensity modulate the crt beam. Normally, in using this control the BRILLIANCE control is adjusted so that the baseline just disappears. Intensity modulation then causes only the signals to appear on the screen in greater contrast.

k. FOCUS: The sharpness of the presentation is adjusted with this control.

l. BRILLIANCE: The intensity of the screen presentation is varied with this control.

m. GAIN: The amplitude of the deflections on the crt screen is adjusted with the GAIN control. Whenever possible lower gain should be used to reduce the size of both spurious and noise deflections provided that the maximum allowable signal input within the bandpass region for spurious indications below 40 db is not exceeded. (See Paragraph I-5, ELECTRICAL CHARACTERISTICS). For applications in which spurious indications which may be introduced by the Panalyzor are objectionable, the point on the GAIN control at which spurious indications increase should be determined. The GAIN control range may be divided approximately as follows: the clockwise two-thirds of the control range should be used to obtain spurious-free presentations. The use of the counterclockwise one-third of the range control may result in spurious indications. To determine with precision the point on the control beyond which spurious indications become objectionable, feed in the maximum signal for spurious-free presentation (at a frequency within the pass-band) and adjust the GAIN control for full-scale LOG presentation. This is the desired point. If the spurious indications are not objectionable and larger input signals are of interest, the signal amplitude may be increased while at the same time maintaining the signal pip height at full scale, until spurious indications become objectionable. Any position of the GAIN control, clockwise of this position, will not have objectionable spurious indications, providing the signal level used to determine this point is not exceeded. When it is necessary to examine signals within the band-pass region which exceed the maximum allowable signal input, suitable external attenuation should

be used to allow use of the GAIN control in the spurious-free region of its rotational range. It is necessary to check for spurious indications introduced by the Panalyzor throughout its band-pass region.

I-8. TUBE COMPLEMENT

The tubes employed are as follows:

Symbol		Type	Function
V1		6BE6	Signal Mixer
V2		6BH6	Bandpass Amplifier
V3		6BE6	Converter
V4		6AH6	Reactance Tube Modulator
V11		12AT7	a. 1st Xtal I-F Amplifier b. 2nd Xtal I-F Amplifier
V12		6BH6	3rd I-F Amplifier
V13		6AU6	4th I-F Amplifier (LIN-LOG)
V14		12AU7	a. Detector b. First Vertical Amplifier
V15		12AU7	a. Vertical Phase Inverter b. Intensifier
V16		12AT7	Sync Amplifier
V17		6U8	a. Sawtooth Generator b. Cathode Follower
V18		12AU7	a. Horizontal Amplifier b. Phase Inverter
V19	#	5UP7	Cathode-Ray Tube
V20		0C3	Voltage Regulator
V21		6U8	a. Astigmatism b. Blanking Amplifier
V23		12AT7	a. Exponential Detector b. Exponential Amplifier
V101	*	5V4GA/B	Low Voltage Full-Wave Rectifier

\# 5ADP7 in Z modification equipments.
* In Power Supply PS-8b.

I-9. TERMS AND DEFINITIONS

a. Panoramic Reception is the simultaneous visual reception of a continuous portion of the frequency spectrum.

This definition distinguishes panoramic reception from the conventional reception which can be called "uni-signal" reception and which can be either aural or visual or both.

The main distinction between Panoramic and uni-signal reception is the following: Panoramic reception is periodic reception over a wide range of the spectrum. Each signal is received at fixed, rapid intervals, for a short period of time. (These signals are received so rapidly as to appear to be continuous.) Uni-signal reception is continuous reception, of the one signal at a time, over a very narrow range of the spectrum.

b. Sweep width is the band, measured in cycles, kilocycles or megacycles, which can be observed by Panoramic reception and which corresponds to the range of oscillator sweep in the Panoramic equipment.

c. Base Line is the horizontal line produced by the electron beam sweeping across the cathode-ray tube.

d. Frequency Sweep Axis is the line along which the signal deflections are produced and which can be calibrated in frequency according to a given frequency scale.

e. Center Frequency is the frequency of the signal received on that part of the frequency sweep axis corresponding to zero sweep voltage applied to the reactance modulator.

f. Resolution of a given signal is the frequency difference, measured along the frequency sweep axis, between the points where its deflection is 30% down from the peak value. This characteristic corresponds to "selectivity" in ordinary receivers. The smaller this frequency difference, the better the resolution.

g. Sweep Rate is the number of times per second the electron beam sweeps across the cathode-ray tube.

h. Deflection Amplitude is the visual equivalent of signal input voltage. It is the height of a given signal deflection measured from the baseline to the top of the deflection.

i. Screen Scale is the scale adjacent to the base line which is calibrated in frequency units above and below center frequency for a maximum sweep width setting.

j. External Oscillator is the associated unit which is used with the Panalyzor to heterodyne with the test signal to produce the required input frequency of the Panalyzor.

NOTE: The heterodyne product should be the difference between the two frequencies used. If the sum frequency were used, spurious screen indications would result from heterodyne products of the test signals and the external signal generator output (including its harmonics).

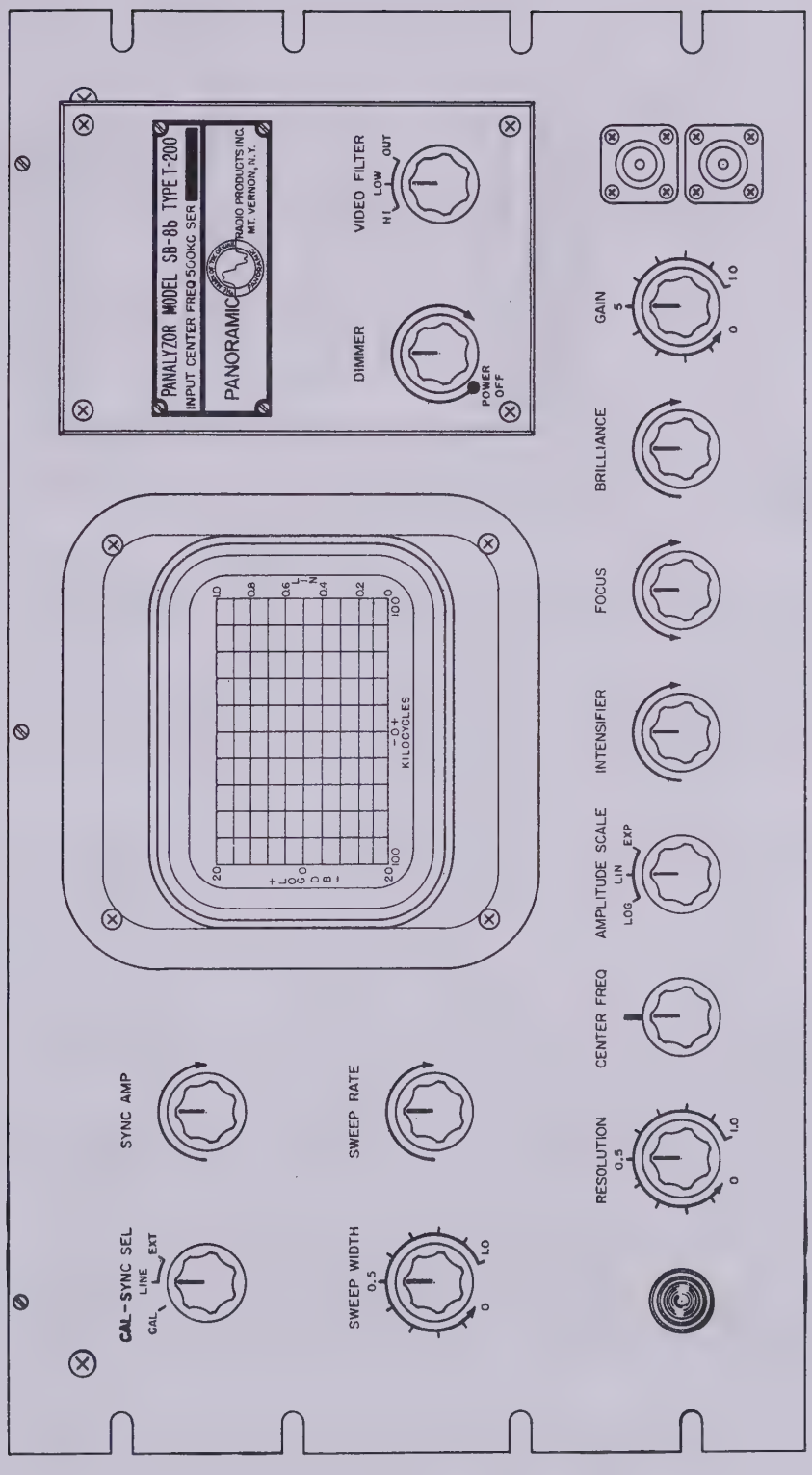


Figure I-2. Front Panel, Model SB-8bY, Type T-200

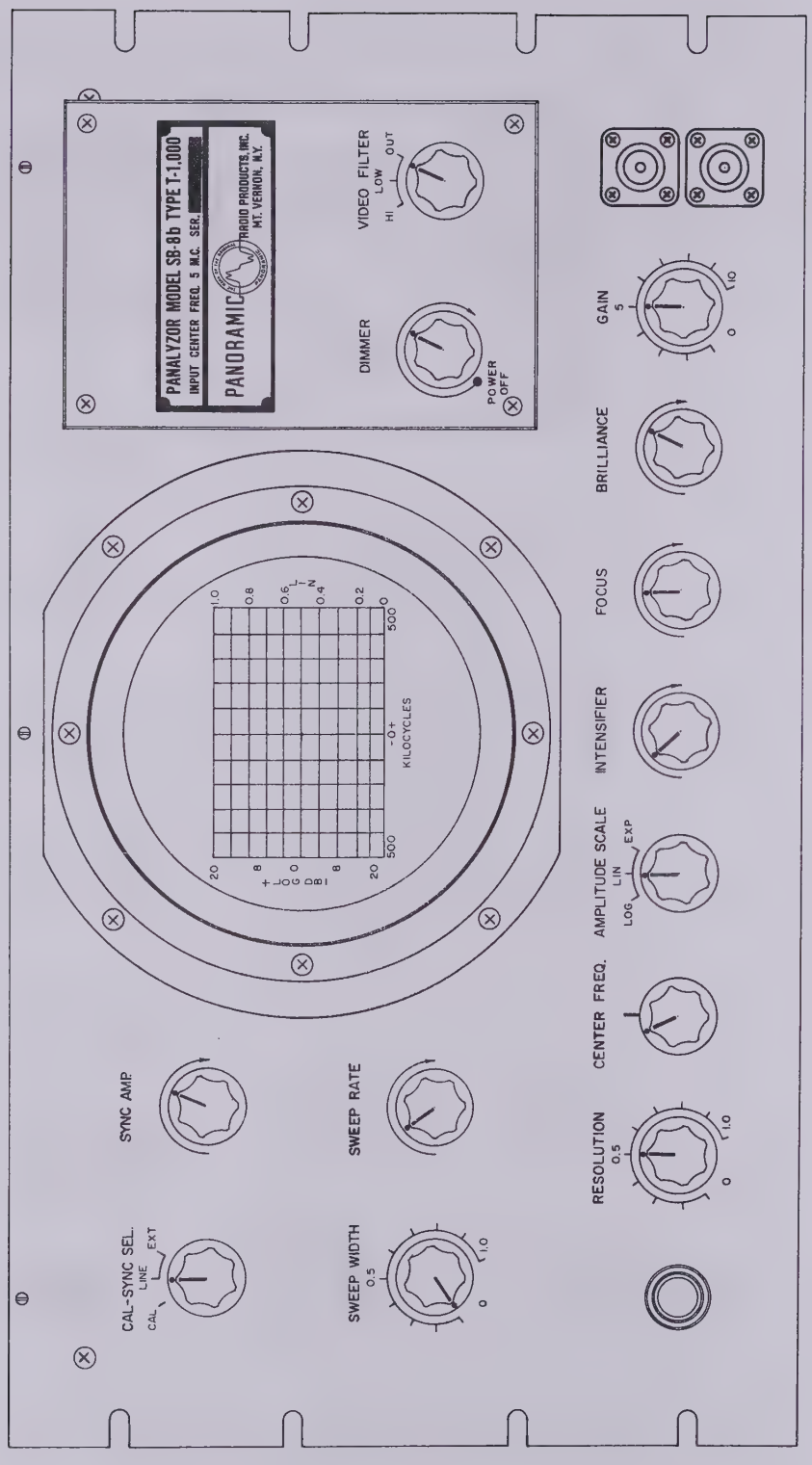


Figure I-3. Front Panel, Model SB-8bZ, Type T-1000

CHAPTER II - INSTALLATION

II-1. INITIAL INSPECTION

This instrument has been tested and calibrated before shipment. Only minor preparations are required to put the instrument in operation.

If damage to the case is evident when delivery is made, have the person making the delivery describe the damage and sign the notation on all copies of the delivery receipt.

Most public carriers do not recognize claims for concealed damage if such damage is not reported within fifteen days after delivery. All shipping containers should be opened and the equipment inspected before fifteen days elapse.

If damage is found, whether concealed or obvious when delivered, call or write the carrier and ask that an inspection be made by their agent.

Although the carrier is liable for any damage in the shipment, Panoramic Radio Products, Inc. will assist in describing and providing for repair or replacement of damaged items.

The equipment is shipped with all tubes and crystals installed. Check that all such components are properly seated in their sockets.

II-2. INTERCONNECTING PROCEDURE

NOTE: The power supply of the Panalyzor is factory wired for 118 volt, 50-60 cps operation. In order to deliver a stable supply of this power requirement, a constant-voltage transformer is supplied. This transformer must be considered an integral part of the Panoramic equipment and must be used at all times. Do not, however, use it to supply power to auxiliary or additional equipments. For satisfactory operation of the Panoramic equipment, the c-v transformer must be used only within the input voltage range and only at the frequency specified on its nameplate. Normally, a c-v transformer with one of the following four voltage-frequency combinations is supplied, depending on the purchase order.

Input Voltage	Frequency	Output Voltage
1. 95 - 125V	60 cps	118
2. 95 - 135V	50 cps	118
3. 190 - 250V	60 cps	118
4. 190 - 250V	50 cps	118

Connect the units according to the Interconnecting Diagram, Figure II-1. The following table lists the cables supplied with the equipment and the connections to be made.

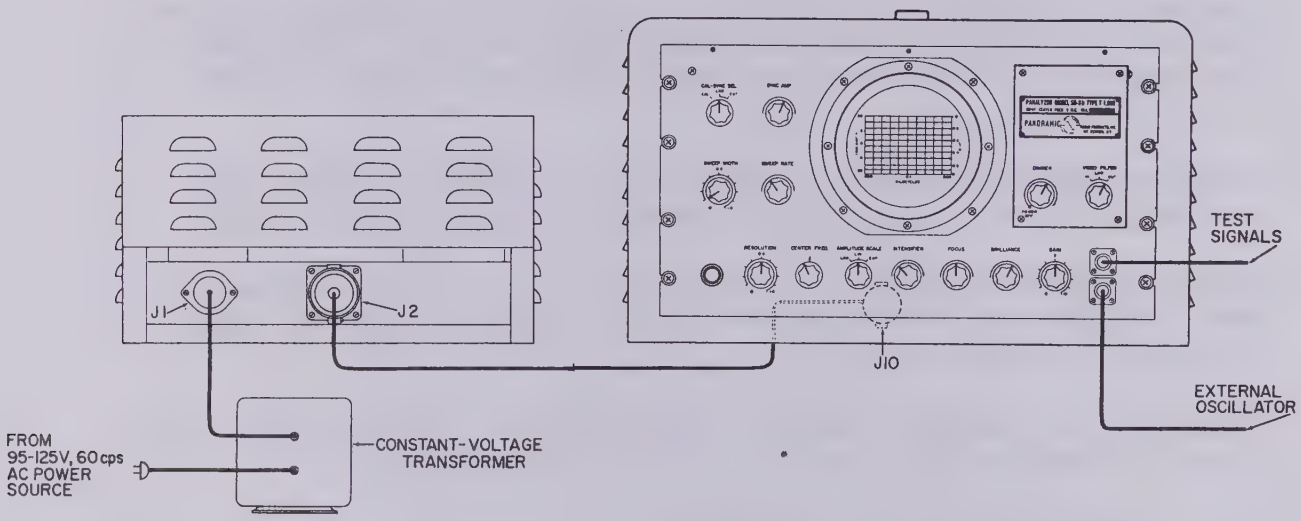


Figure II-1. Interconnecting Diagram

Cable Description	Connection	
	From	To
14 wire interconnecting power cable.	J10, rear of Analyzer Chassis	J2, rear of Power Supply Chassis
3 wire power cable with female plug	Constant-voltage transformer	J1, rear of Power Supply Chassis
3 wire power cable with male plug	Constant-voltage transformer	Suitable source of 117V AC power

Cable Description	Connection	
	From	To
Coaxial cable with 1 Type N connector	J101, on Analyzer front panel	External Test Signals *
Coaxial cable with 1 Type N connector	J102, on Analyzer front panel	External Oscillator *

* These signals may be applied to either the upper or lower connector. For optimum performance, the larger of these signals should be connected to the upper connector.

NOTE: If the signal generator frequency is not varied during examination of the test signal, the connecting cable need not match the 50-ohm input impedance of the Panalyzor. This also applies when flatness of response is not critical. Otherwise the generator cable must be 50-ohms and nonterminated or a suitable pad should be used to prevent reflections and the resultant nonuniform response due to mismatch.

If the test signal has a dc component and the Panoramic cable is to be connected directly to the signal source, a suitable blocking capacitor should be used at the free end of the cable.

II-3. INSTALLATION ADJUSTMENTS AND CHECKS

a. Turn the power on with the DIMMER control. The pilot light should go on at once. When the crt is a 5ADP7, clockwise rotation of the DIMMER control will reduce the brightness of the edge lighting of the crt screen. When a 5UP7 is used, the DIMMER control dims the pilot light. Set the BRILLIANCE control between one-half or two-thirds of maximum clockwise position. Within two minutes the baseline trace should appear as a blurred or sharp line.

b. Perform the following tests:

1. FOCUS: Turn this control through its range. The trace should become sharp or blurred. At some setting of the FOCUS control the baseline will be sharp. Leave the control at this position.

2. BRILLIANCE: Turn this control through its range. The intensity should vary. Focus may also vary. This is normal. Return the control to a position giving a sharp bright trace.

3. INTENSIFIER: Set this control at its maximum counterclockwise position. Turn the GAIN, RESOLUTION and SWEEP WIDTH controls completely clockwise. Noise peaks may appear on the screen. If not, introduce noise or a 500 KC signal into the equipment. Turn the BRILLIANCE control counterclockwise until the deflections almost fade out. Turn up the INTENSIFIER. The noise lines or signals will become brighter but the baseline will not be present.

4. CENTER FREQ: Feed in a signal which corresponds in frequency to the input center frequency of the equipment. Set the GAIN, RESOLUTION and SWEEP WIDTH controls completely clockwise, SWEEP RATE to about three-quarters of its maximum clockwise position and AMPLITUDE SCALE to LIN. If necessary adjust the HORIZONTAL POSITION control so that the trace is centered on the screen. A pip corresponding to the signal should appear on or near the center of the screen. If the deflection consists of many vertical lines, reduce the GAIN until a single pip is present.

   Turn the SWEEP WIDTH control counterclockwise. The pip will broaden and should remain on or near center. If it moves off the screen, adjust the CENTER FREQ control to maintain the centered condition. When the base of the pip occupies the entire screen, return the SWEEP WIDTH control to maximum clockwise position. The pip may now be off-center. If so, adjust the HORIZONTAL POSITION control to center the pip.

   Turn the CENTER FREQ control back and forth. The deflection should shift back and forth horizontally. Return the control to the position which centers the pip on the screen.

5. GAIN: Rotation of this control should change pip height.

6. SWEEP WIDTH: Set the controls as outlined for CENTER FREQ test. With the SWEEP WIDTH control turned completely clockwise, vary the frequency of the signal generator between the limits indicated below:

Type	Input Center Freq.	Frequency Limits
T-200	500 KC	400 KC - 600 KC
T-1000	5 MC	4.5 MC - 5.5 MC

When the limit frequencies are applied, corresponding deflections should appear within one-half division of the horizontal calibration extremities. This will indicate that the scanning width is within specifications.

7. RESOLUTION: Set the controls as outlined for CENTER FREQ test. Feed in a signal which corresponds to the input center frequency of the equipment. Adjust the GAIN control and/or the signal level to give a full scale deflection. Gradually reduce the sweep width so that the pip base covers approximately one-third of the screen. Now turn the RESOLUTION control counterclockwise. The pip width should decrease. At the same time there may be a change in pip height. Rotation through the full range of the RESOLUTION control may result in a major change in pip height. It will also be noticed that small convolutions or "ringing" will appear on the trailing edge of the pip. Best resolution is indicated when the first convolution beyond the apex of the pip dips into the baseline. (See Paragraph III-3 b (5) for a discussion of "ringing" as an indication of best possible resolution).

8. AMPLITUDE SCALE: Set the controls as outlined for CENTER FREQ test. Feed in a signal which corresponds to the center frequency of the equipment. Adjust the pip height for full scale deflection. Switch the AMPLITUDE SCALE selector to LOG. The deflection should go down to 0 db. Switch to EXP and vary the signal level. Full scale deflection should require about 4 times the signal for one-tenth scale.

9. SWEEP RATE: Set the CAL-SYNC SEL on CAL. At maximum clockwise rotation of the SWEEP RATE control one cycle of the line frequency should be visible. As the control is rotated in a counterclockwise direction the number of cycles visible should increase until at the end of the rotation, approximately 60 appear. The sweep rate at any position is equal to 60 cps divided by the number of cycles visible. At low rates, it is easier to count sweeps, using a stop watch for timing, than to count cycles.

10. SYNC AMP: With the CAL-SYNC SEL still in the CAL position, slowly advance this control. At one setting the sine wave display on the screen should "lock in". That is, there should be no drifting horizontally in either direction.

11. CAL-SYNC SEL: For the CAL position see steps 9 and 10. With this control in the LINE position, move the baseline to one side of the crt screen with the HOR POS control so that the end of the line is visible. The SWEEP RATE control should be set for approximately 30 or 60 cps. The SYNC AMP control should be in the maximum counterclockwise position. The end of the line will appear to move back and forth. Slowly advance the SYNC AMP control. At approximately one-quarter rotation, the baseline should remain stationary, indicating that the sweep is synchronized with the power line frequency.

    In the EXT position feed 60 cps from the secondary of a filament transformer (or from any other available low voltage supply at the line frequency) to the EXT SYNC jack. Repeat as in the LINE position.

12. VIDEO FILTER: As this filter is switched in, noise on the screen should be filtered, and signal pips will be integrated and shifted slightly. Greatest effect will be noticed in the HIGH position.

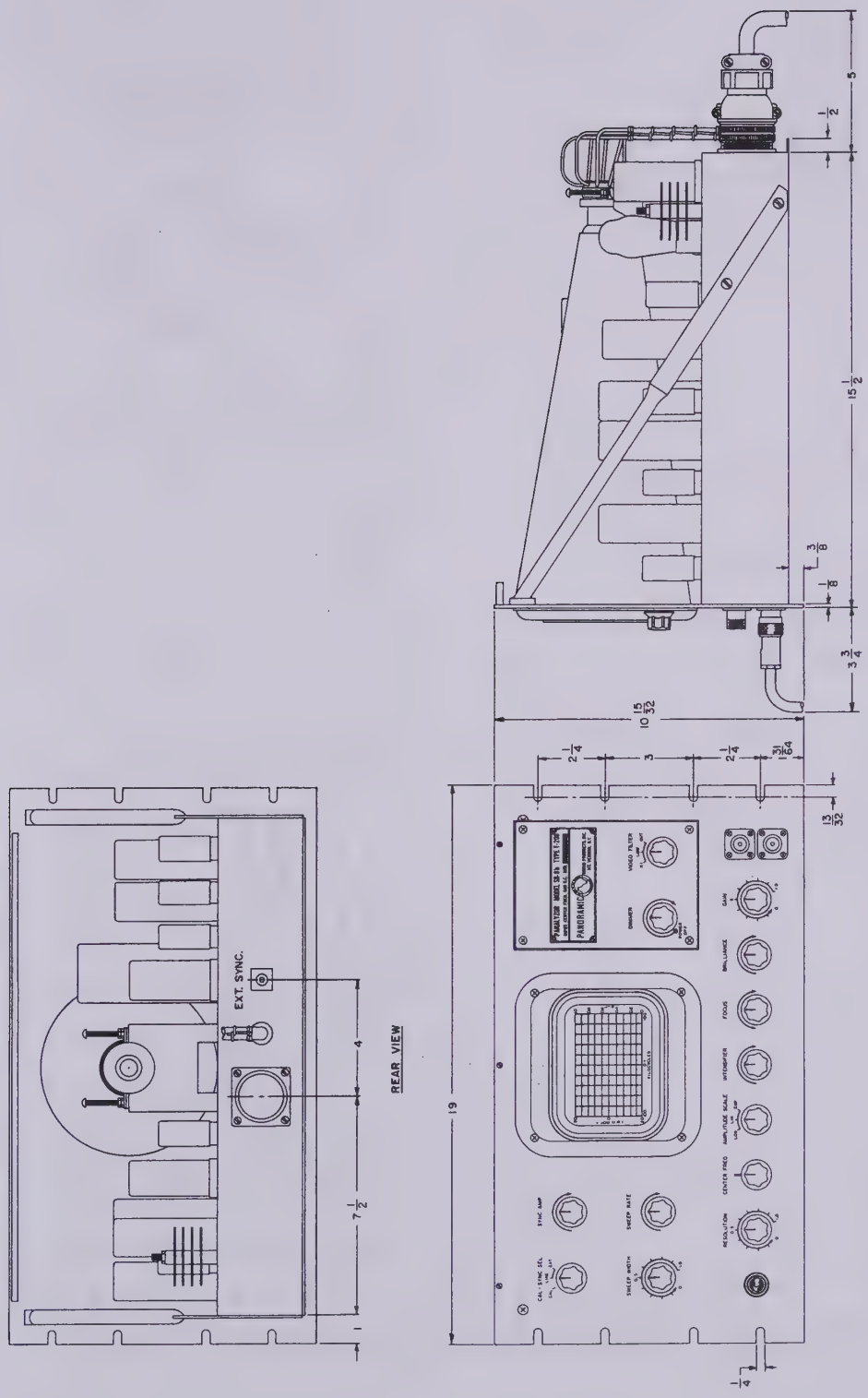


Figure II-2. Outline Dimensional Drawing, Model SB-8bY, Rack Mount Style.

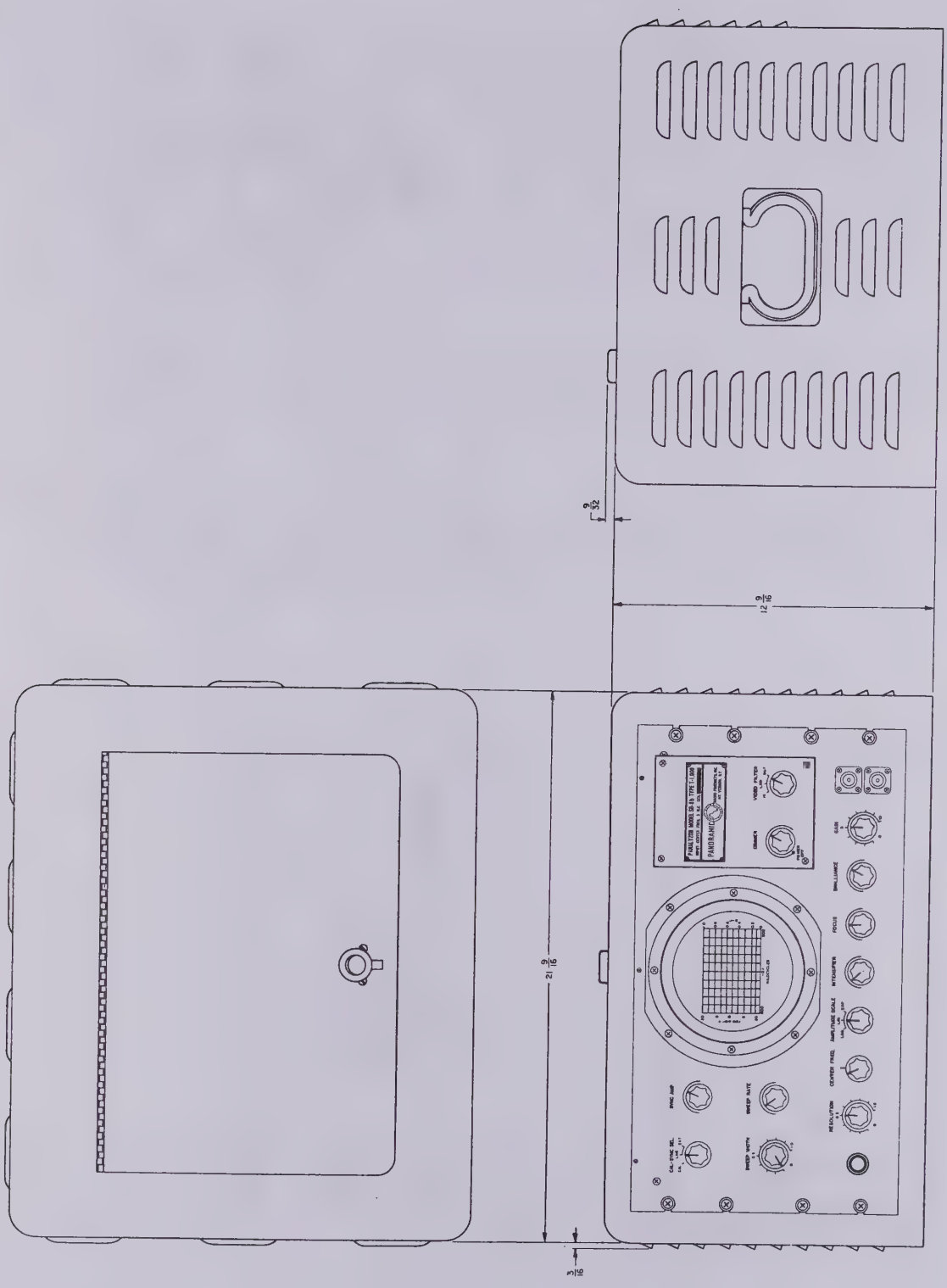


Figure II-3. Outline Dimensional Drawing, Model SB-8bZ, in Cabinet.

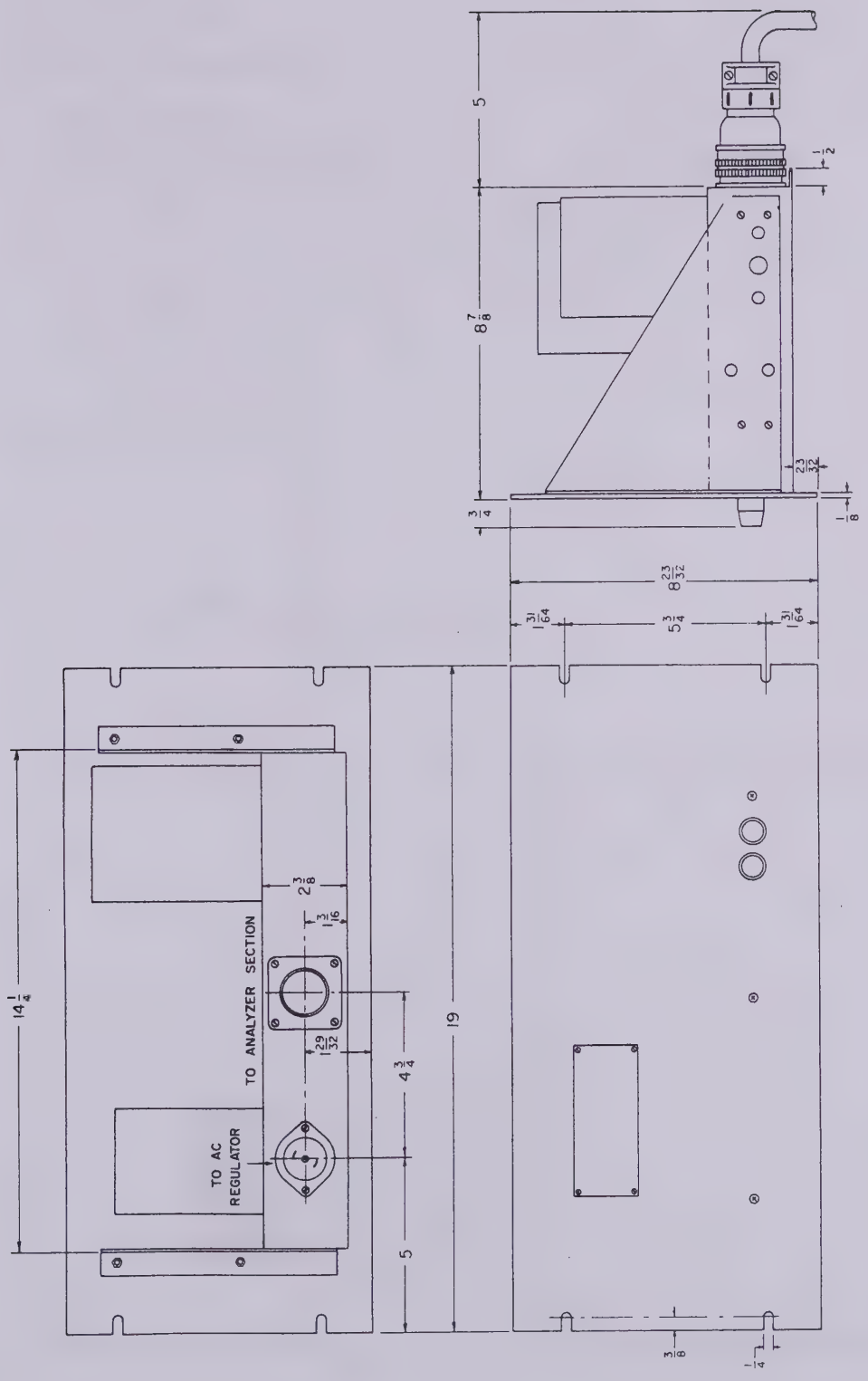


Figure II-4. Outline Dimensional Drawing, Model PS-8b, Rack Mount Style.

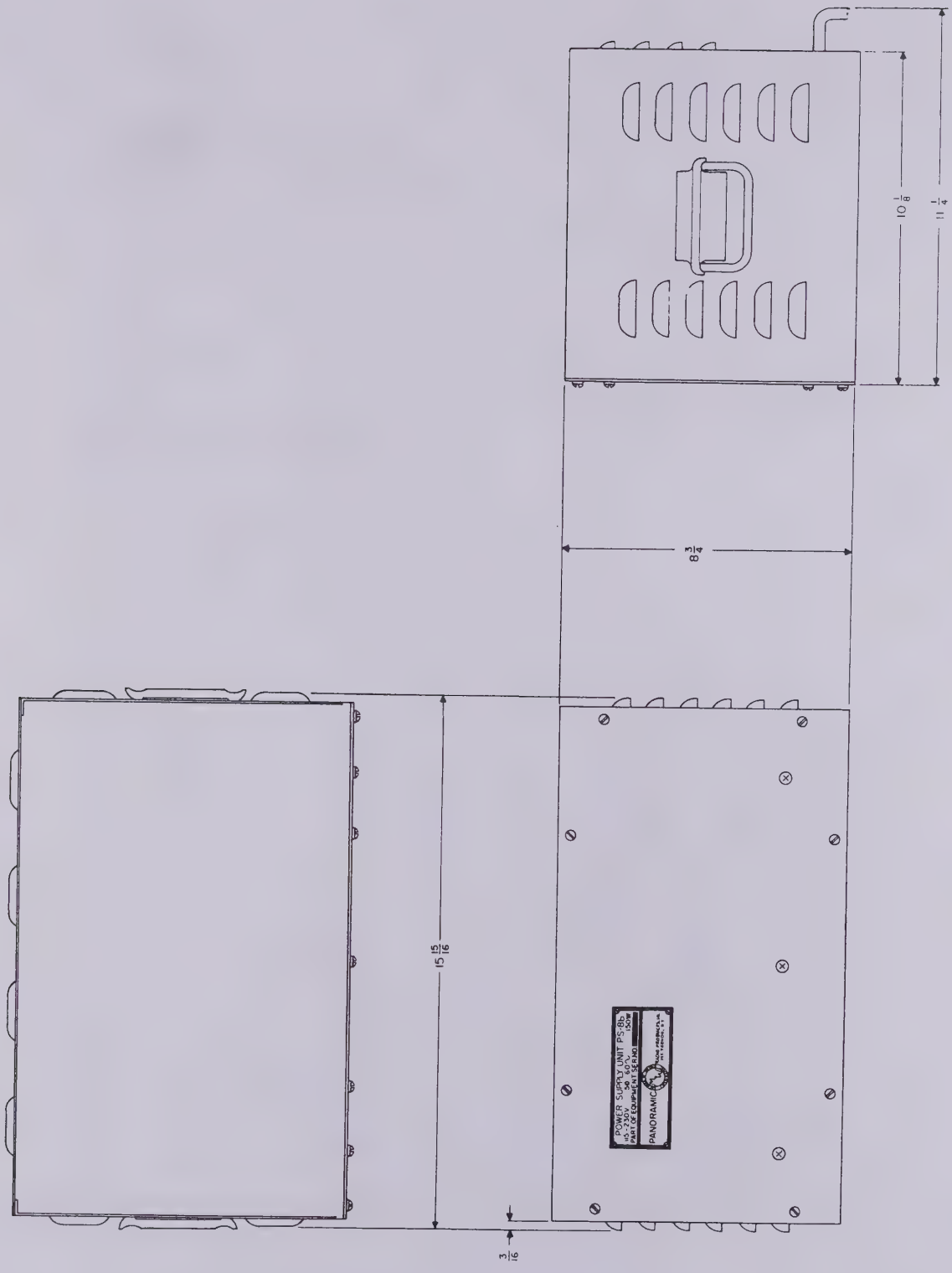


Figure II-5. Outline Dimensional Drawing, Model PS-8b, in Cabinet.

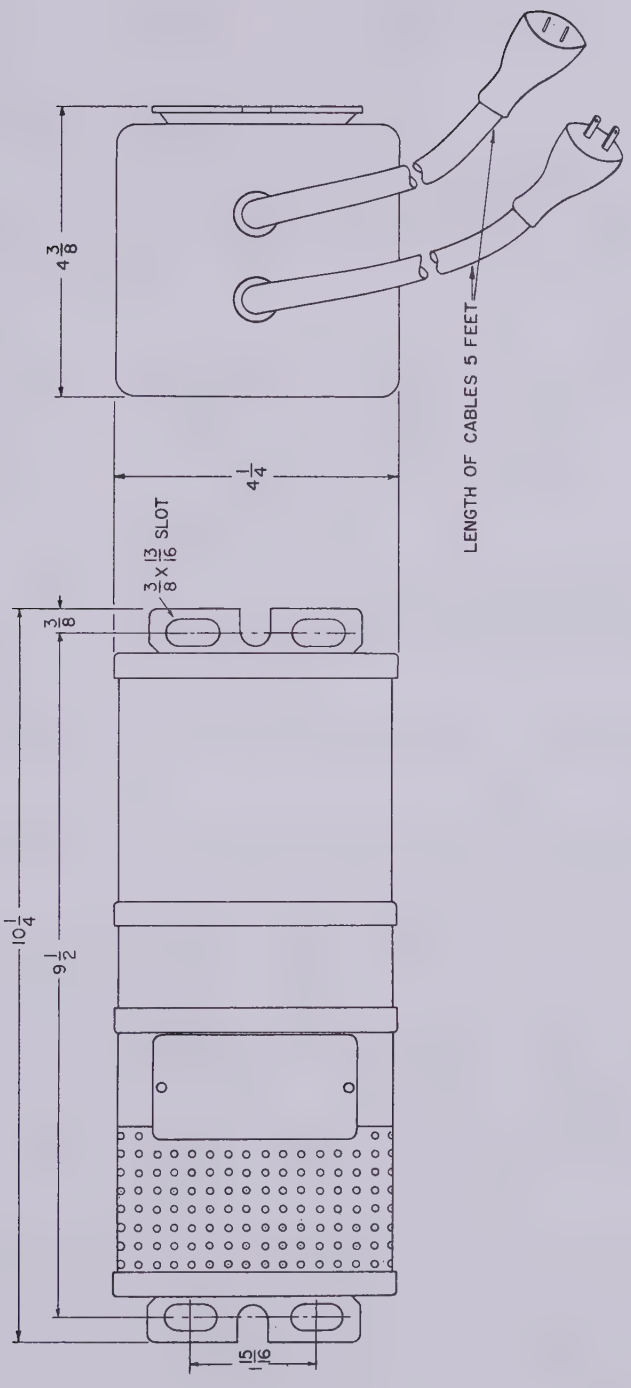


Figure II-6. Outline Dimensional Drawing, Constant-Voltage Transformer

no advantage will be gained by having the external oscillator frequency above that of the test signal.

NOTE: The external oscillator frequency can be recognized as being below the test signal frequency if the pip moves from left (-) to right (+) as the oscillator frequency is increased. When the generator frequency is above the test signal frequency a pip will move from right (+) to (-) as the oscillator frequency is increased.

When the frequency of the external oscillator is above the test signals, the plus and minus signs on the screen apply; that is signals on the (+) side are higher in frequency than the center signal while those on the (-) side are lower. If the oscillator frequency is below the test signals, the signs are reversed. When signals whose frequencies are within the bandpass region, i.e., 400 KC to 600 KC for Type T-200 and 4.5 MC to 5.5 MC for Type T-1000 are fed directly into the input, the screen signs are reversed.

Slowly search the spectrum with the external oscillator until the signal appears at the center of the screen.

To locate the signal, it may be found convenient to operate the Analyzer at maximum gain and the external oscillator for high output. Once the signal is located, the GAIN control may be backed off in a counterclockwise direction and the oscillator output lowered to obtain a signal which falls below full scale.

c. The table below outlines the method of determining the actual frequencies of signals appearing on the screen.

Signal appears to the LEFT of the center (0) calibration	Signal appears to the RIGHT of the center (0) calibration
IF THE EXTERNAL OSCILLATOR IS ABOVE THE TEST SIGNAL:*	
1. Subtract the input center frequency from the external oscillator frequency. then:	1. Subtract the input center frequency from the external oscillator frequency then:

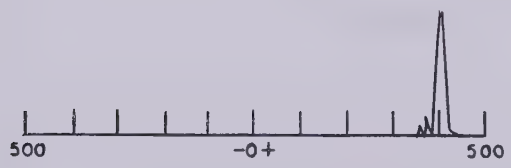
* Determined by the procedure outlined in NOTE of Paragraph b above.

Signal appears to the LEFT of the center (0) calibration	Signal appears to the RIGHT of the center (0) calibration
IF THE EXTERNAL OSCILLATOR IS ABOVE THE TEST SIGNAL *	
2. Subtract the screen calibration from the result of step 1.	2. Add the screen calibration to the result of step 1.
IF THE EXTERNAL OSCILLATOR IS BELOW THE TEST SIGNAL * (Screen signs are reversed)	
1. Add the input center frequency to the external oscillator frequency. then: 2. Add the screen calibration to the result of step 1.	1. Add the input center frequency to the external oscillator frequency. then: 2. Subtract the screen calibration from the result of step 1.

* Determined by the procedure outlined in NOTE of Paragraph b above.

EXAMPLES:

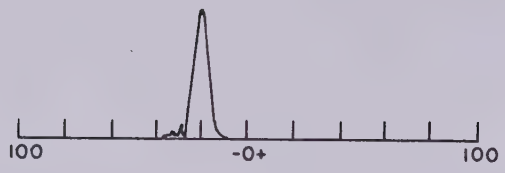
1.



A Type T-1000 is adjusted for maximum sweep width. At maximum sweep width each frequency calibration mark is equivalent to 100 KC. A signal pip appears at +400 (to the right of the screen). The external oscillator is set to 107.400 MC. The input center frequency of the Type T-1000 is 5 MC. When the external oscillator frequency is raised the signal pip moves from right to left. This indicates that the external oscillator is ABOVE the test signal (Paragraph b, NOTE). Following the procedure outlined in the table above, the signal frequency is:

1. 107.400 MC - 5 MC =102.400 MC
then:
2. 102.400 MC + .4 MC=102.800 MC
therefore:

Signal Frequency = 102.800 MC



A Type T-200 is adjusted for maximum sweep width. At maximum sweep width each frequency calibration mark is equivalent to 20 KC. A signal pip appears at -20 (to the left of the screen). The external oscillator is set to 7.3000 MC. When the external oscillator frequency is raised the signal pip moves from right to left. This indicates that the external oscillator is below the test signal (Paragraph b, NOTE).

Following the procedure outlined in the table above, the signal frequency is:

1. 7.300 MC + .500 MC = 7.800 MC
then:
2. 7.800 MC + .020 MC = 7.820 MC
therefore:

Signal frequency = 7.820 MC

III-2 RELATIVE AMPLITUDE MEASUREMENTS

The relative amplitudes of test signals are proportional to the relative heights of the corresponding deflections on the screen of the crt within the limits specified for flatness of response. (The use of a pre-amplifier may affect this flatness).

To observe signals of comparative amplitude (10:1 or less), the AMPLITUDE SCALE should be set to LIN. In this position, the horizontal calibration lines on the crt screen are used. The linear scale is calibrated in ten divisions.

Examination of signals widely divergent in amplitude will require setting the AMPLITUDE SCALE switch to the LOG position. This will allow simultaneous reading of amplitude having a 40 db range. In this position of the AMPLITUDE SCALE switch, the calibration dots at the left side of the screen are used. The calibration range is from -20 db to +20 db in 5 db steps for a total range of 40 db.

In the EXP position, differences in amplitude are accentuated. In this position the relative deflections of discrete frequency pips are proportional to the squares of their respective amplitudes, i.e., to their respective powers. The EXP scale permits direct determination of power points, side-band energies, etc. This position also aids in distinguishing between signals and noise.

Additional separation of signal from noise can be obtained by setting the VIDEO FILTER to either LOW or HIGH.

III-3 NARROW-BAND ANALYSIS

At full sweep width, test signals, or a carrier and its side-bands, having a small frequency difference tend to have their corresponding deflections merge into and mask each other. These deflections may be separated (resolved) by increasing the scanning time (reducing the sweep rate), by reducing the sweep width, or by narrowing the i-f bandwidth at the same time the sweep rate and/or the sweep width is reduced.

Figures III-1 and III-2 are graphs which indicate the relationship between resolution and sweep width at sweep rates of 30 cps, 10 cps, 3 cps and 1 cps. Figure III-1 applies to Type T-200. Figure III-2 applies to Type T-1000. The graphs are used as guides for determining whether signals can be resolved. For a given setting of the SWEEP WIDTH control and for any one sweep rate, there is a setting of the RESOLUTION control which will produce the best resolution. The following example illustrates how the resolution characteristic graph for Type T-1000 (Figure III-2) is used.

Assume that a test signal with 50 side-bands, 2 KC apart is to be observed. The overall sweep width is determined to be 100 KC (50 x 2 KC = 100 KC).

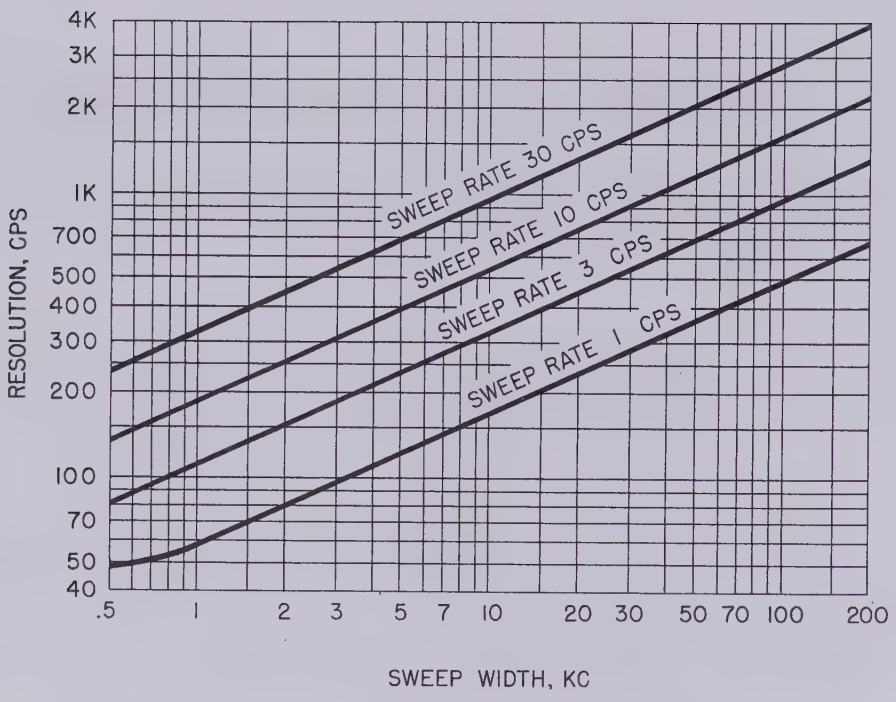


Figure III-1. Resolution (KC) vs Sweep Width (KC)
Type T-200

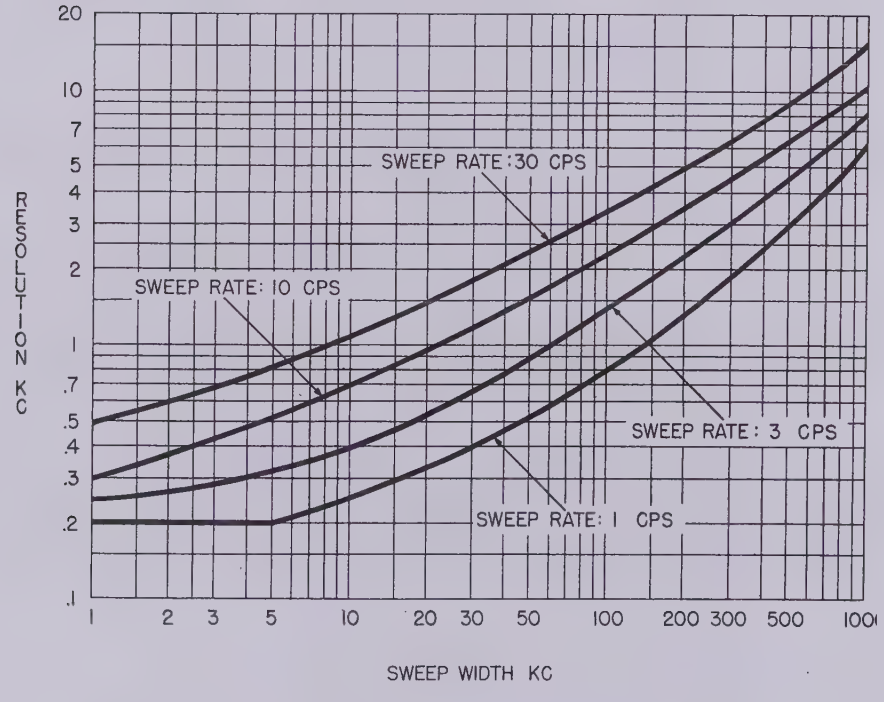


Figure III-2. Resolution (KC) vs Sweep Width (KC)
Type T-1000

With the SWEEP WIDTH control set for 100 KC and the SWEEP RATE control set for 30 cps, the best resolution is 3.3 KC. At 10 cps, the best resolution is 2.3 cps. At 3 cps, the best resolution is 1.4 KC. At 1 cps, the best resolution is 0.8 KC.

Thus to resolve the test signals involved in the example (50 side bands, 2 KC apart), a sweep rate of 3 cps or slower should be used to obtain the required resolution (2KC) at a 100 KC sweep width.

Figures III-3 and III-4 are graphs which indicate the minimum frequency separation required to measure amplitude ratios E_2/E_1.

Figure III-3 applies to the Type T-200. Figure III-4 applies to the Type T-1000.

If a signal of small amplitude is close in frequency to a signal of large amplitude, the pip due to the small signal will be influenced by the presence of the large pip. In effect, the small pip will ride on the skirt of the large pip (the amplitude-versus-frequency response of the i-f section being bell-shaped). As the signals are separated in frequency, the error becomes less. The curves in Figures III-3 and III-4 indicate the separation required for negligible error at the given scanning velocities.

a. To obtain greater resolution by increasing the scanning time, lower the sweep rate by rotating the SWEEP RATE control counterclockwise. Readjust the SYNC AMP control to keep the sweep in synchronism.

b. To increase the resolution capabilities by reducing sweep width, narrowing the i-f bandwidth, and increasing scanning time use the following procedure:

    1. Set the RESOLUTION control on 1.0 (completely clockwise), the position for broadest i-f bandwidth.

    2. With the external oscillator, tune the desired band of signals to the center of the screen.

    3. Spread the band of signals across the screen by turning the SWEEP WIDTH control counterclockwise. Note that at reduced sweep width each screen frequency calibration mark represents a frequency separation equal to one-tenth of the reduced sweep width. Keep the band centered with the CENTER FREQ control.

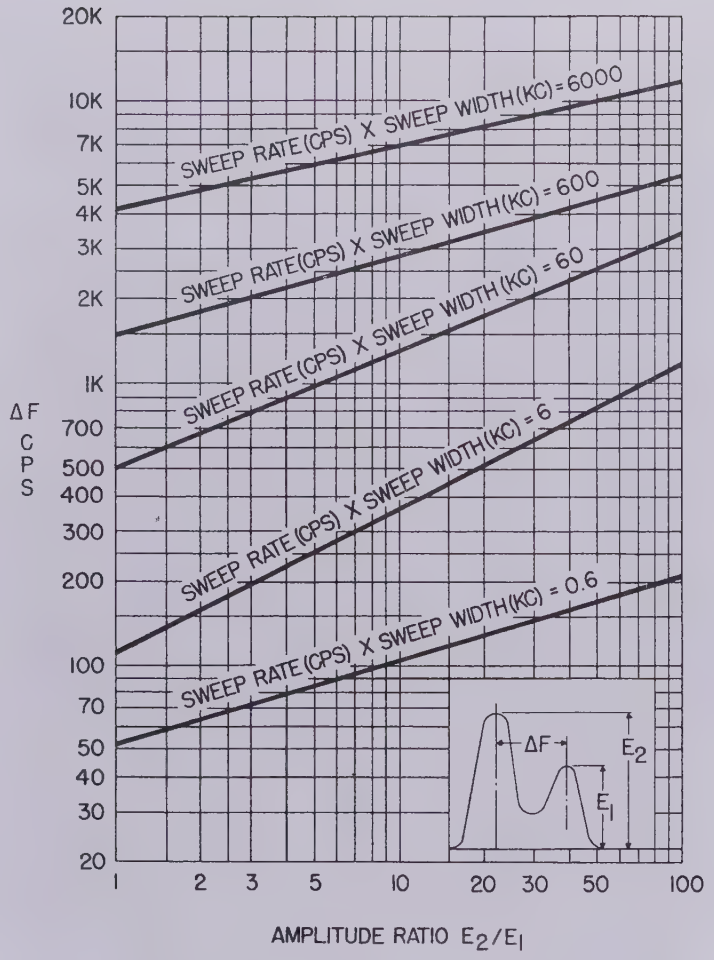


Figure III-3.
Minimum Frequency Separation ΔF,
Required to Measure Amplitude Ratios E_2/E_1.
Type T-200

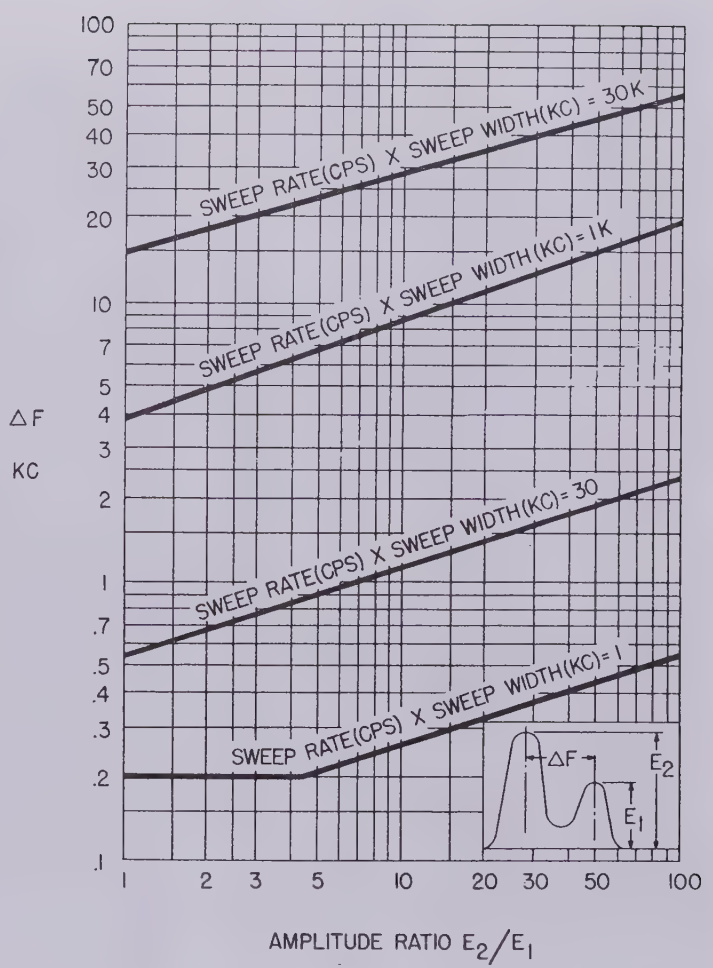


Figure III-4.
Minimum Frequency Separation ΔF,
Required to Measure Amplitude Ratios E_2/E_1.
Type T-1000

When the SWEEP WIDTH control is set close to its maximum counterclockwise position, the center signal will appear as an elevated baseline or pip with hum superimposed.

This is normal. However, the sweep width need not be reduced so far in normal analysis. Note that the SWEEP WIDTH control panel markings are only approximate.

4. Turn the RESOLUTION control counterclockwise until individual signals are most clearly resolved. If the signal is not resolved, a slower sweep rate must be used. Best resolution can be recognized by the nature of the ringing pulses which will appear on the trailing edge of the signal pip as the best possible resolution is approached. See Figure III-5 and Subparagraph 5 below. Ringing can be seen more easily with the VIDEO FILTER control in the OUT position.

   NOTE: Rotation of the RESOLUTION control may result in increased or decreased pip height. Pip amplitude may be returned to a suitable level with the GAIN control. Turning the RESOLUTION control counterclockwise after best resolution is reached will decrease the resolving power and result in greatly reduced sensitivity.

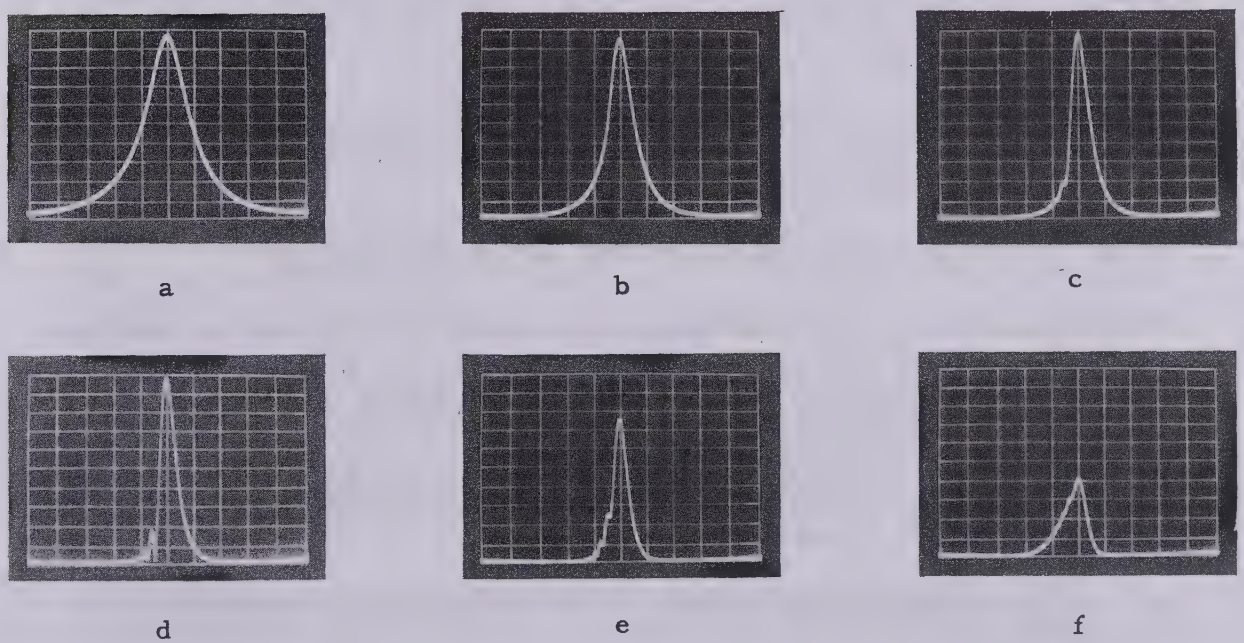


Figure III-5. Ringing as an Indication of Optimum Resolution.

5. If the resolution adjustment results in practically complete separation of signal pips, best resolution can be recognized by the presence of ringing pulses on the trailing edge of the pip.

   Waveforms (a) through (f) of Figure III-6 indicate the progressive variations in pip shape caused by counterclockwise rotation of RESOLUTION control. In (a) and (b) the i-f bandwidth is broad for a given scanning velocity (product of sweep rate and sweep width). Waveform (c) shows beginning of ringing. Extent of ringing in (d) shows best possible resolution. Note that at best resolution the notch between the signal pip and the ringing pip nearest the signal pip extends into the baseline. As the i-f bandwidth is made narrower, excessive ringing widens the signal pip and decreases the pip amplitude thus reducing the resolving power. Further counterclockwise rotation of the RESOLUTION control causes a reduction in amplitude and re-merging of the pips. This is shown in waveforms (e) and (f).

6. To better separate the signals, the SWEEP WIDTH and RESOLUTION controls can be backed off further counterclockwise and the SWEEP RATE control set to give a slower rate.

   If it is mandatory to observe a given bandwidth at one time and the signals contained therein are so closely spaced that they cannot be completely resolved, best possible resolution is recognized by the appearance of the clearest picture. After this point has been reached, further counterclockwise rotation of the RESOLUTION control will result in lessened resolution and a bobbing presentation.

   Better resolution can be obtained by looking at narrow segments of the bandwidth of interest, and shifting the center frequency to cover the entire band.

III-4 OPERATING PROCEDURE FOR PULSED SIGNALS

Pulsed signals are composed of a series of pulses which are of relatively short duration. Therefore, a peak produced by one of these pulses traverses the screen vertically for so short a period that the crt screen is not sufficiently excited to produce a visible trace. Merely turning up the BRILLIANCE control does not help because the increased brightness of the baseline tends to "wash out" the pulse pattern. Therefore, the following procedure should be used.

a. Set up the equipment as outlined in Paragraph III-1, GENERAL OPERATION.

b. Using the BRILLIANCE control, reduce the brightness of the baseline trace so that it is barely visible.

c. Turn the INTENSIFIER control clockwise. The pulse peaks should come into view while the baseline is not equally apparent. If necessary, adjust the FOCUS control for the sharpest presentation.

NOTE: The LOG position of AMPLITUDE SCALE selector does not function properly when narrow pulses are involved.

III-5 INTERPRETATION OF SCREEN PRESENTATIONS (See Fig. III-2)

With a little experience, the operator will be able to recognize the visual character of the various types of signals.

a. A constant carrier (Fig. III-6, a & b) appears as a deflection of fixed height.

b. An amplitude-modulated carrier (Fig. III-6, c & d) appears as a deflection of variable height. Non-constant tone modulation of low frequency will produce a series of convolutions varying in height, their number being determined by the modulation frequency. The nature of the presentation will depend upon the scanning width.

As the modulation frequency increases, the convolutions move toward the two sides of the deflection, as the side bands tend to become visible. When the modulation frequency is increased, it becomes possible to separate the side bands by reducing the sweep width of the analyzer. Operation of the RESOLUTION control will effect further separation. The higher the frequency of modulation, the farther away these side bands will move from the center deflections, representing the carrier. Due to possible non-linear amplification of the receiver or of the analyzer, or both, over a wide band, the side bands may appear unequal in height, even though they are of equal strength. The relative heights of the side bands may vary as the receiver is tuned and as the deflection moves from one end of the screen to the other.

c. Single side-band modulation (Fig. III-6, g & h) appears as two carriers of slightly different frequency (See "Signal Interference" below).

d. A carrier frequency-modulated at low rate appears as a carrier which wobbles sideways.

e. A CW signal appears and disappears in step with the keying of the transmitter. During the moments when the signal is off, the frequency sweep axis is closed at the base of the signal. In very rapidly keyed signals the deflection and the baseline are seen simultaneously.

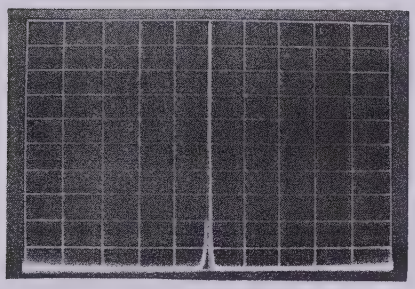
f. A MCW signal appears like a CW signal of periodical varying height. If the modulation rate is high, sidebands will appear as explained above.

g. Signal Interference (Fig. III-6, g & h). Two signals which are so close in frequency as to cause aural interference (beats) may appear on the screen as a single deflection, varying in height as with a modulated signal. As the frequency separation is increased, the deflection appears to be modulated on one side only. Further increase of frequency will cause a "break" in the apex of the deflection. By reducing the sweep width of the analyzer, the respective deflections will gradually separate. Further separation can be made with the RESOLUTION control and by setting the SWEEP RATE control to give a lower rate.

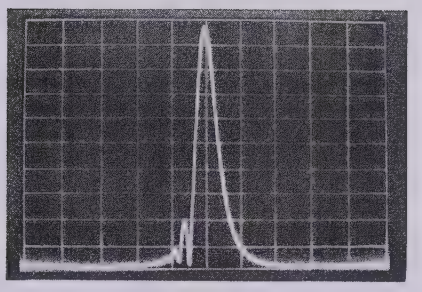
h. Transient disturbances, generally examined, are of two types: periodic and aperiodic transients.

Periodic transients, such as produced by motors, vibrators, buzzers, etc., appear as signals moving along the frequency sweep baseline in one direction or another. Thus an engine which is accelerating will produce a set of deflections which may move first in one direction, slow down, stop and then move in an opposite direction. This is caused by the fact that the analyzer is sweeping at a fixed rate, whereas the transient occurs at a variable rate. The images stand still on the screen when there is synchronism between the two. If the transient disturbance is synchronized with the 60 cps line, the "noise" appears as a fixed signal which, however, does not move on the screen when the receiver is tuned, but only varies in height. Such deflections may appear like amplitude-modulated signals or like steady carrier. Aperiodic transients, such as "static" appear as irregular deflections and flash along the whole frequency sweep axis.

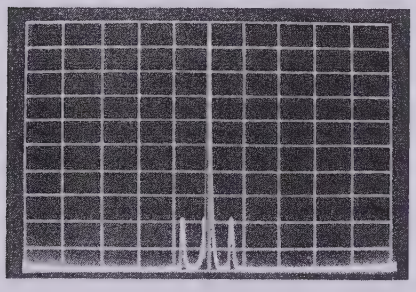
i. Images. Images will be distinguishable from normal signals by the fact that they move in an opposite direction with respect to normal signals on the screen of the analyzer when the external oscillator is being tuned. Such images are most likely to appear on the higher frequency ranges.



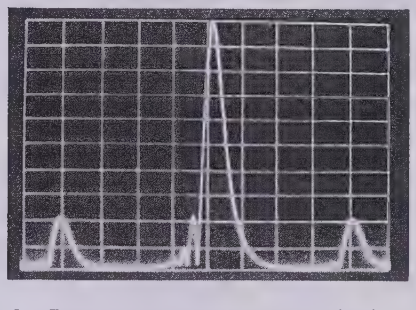
a. Constant carrier signal at approximately maximum sweep width.



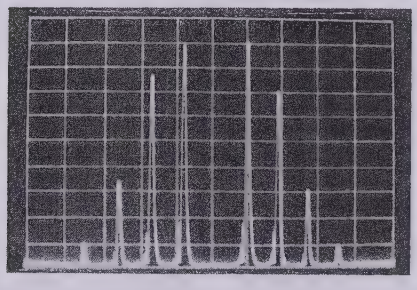
b. Appearance of constant carrier at reduced sweep width.



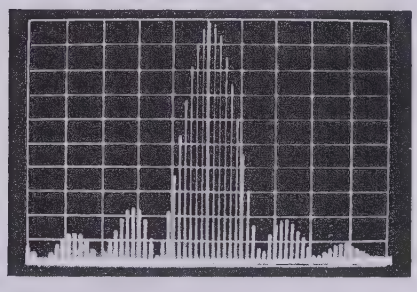
c. Amplitude-modulated signal, showing carrier and two sidebands.



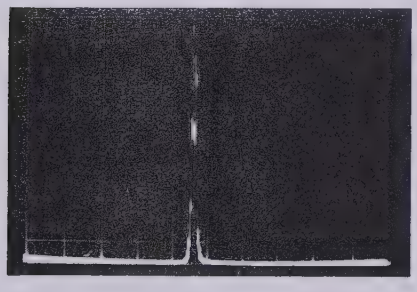
d. Same am signal as "c" at reduced sweep width, carrier remains at center of screen.



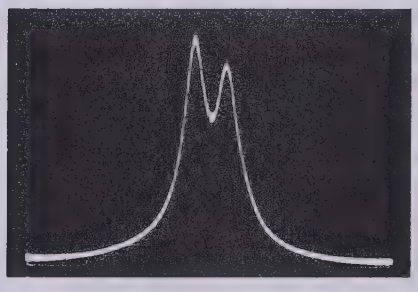
e. Frequency distribution of an fm signal.



f. Spikes indicating distribution of a pulsed rf signal.



g. Two interfering carriers at maximum sweep width.



h. Same signals as "g" at reduced sweep width, resulting in improved separation or resolution.

Figure III-6 Appearance of Typical Panoramic Indications

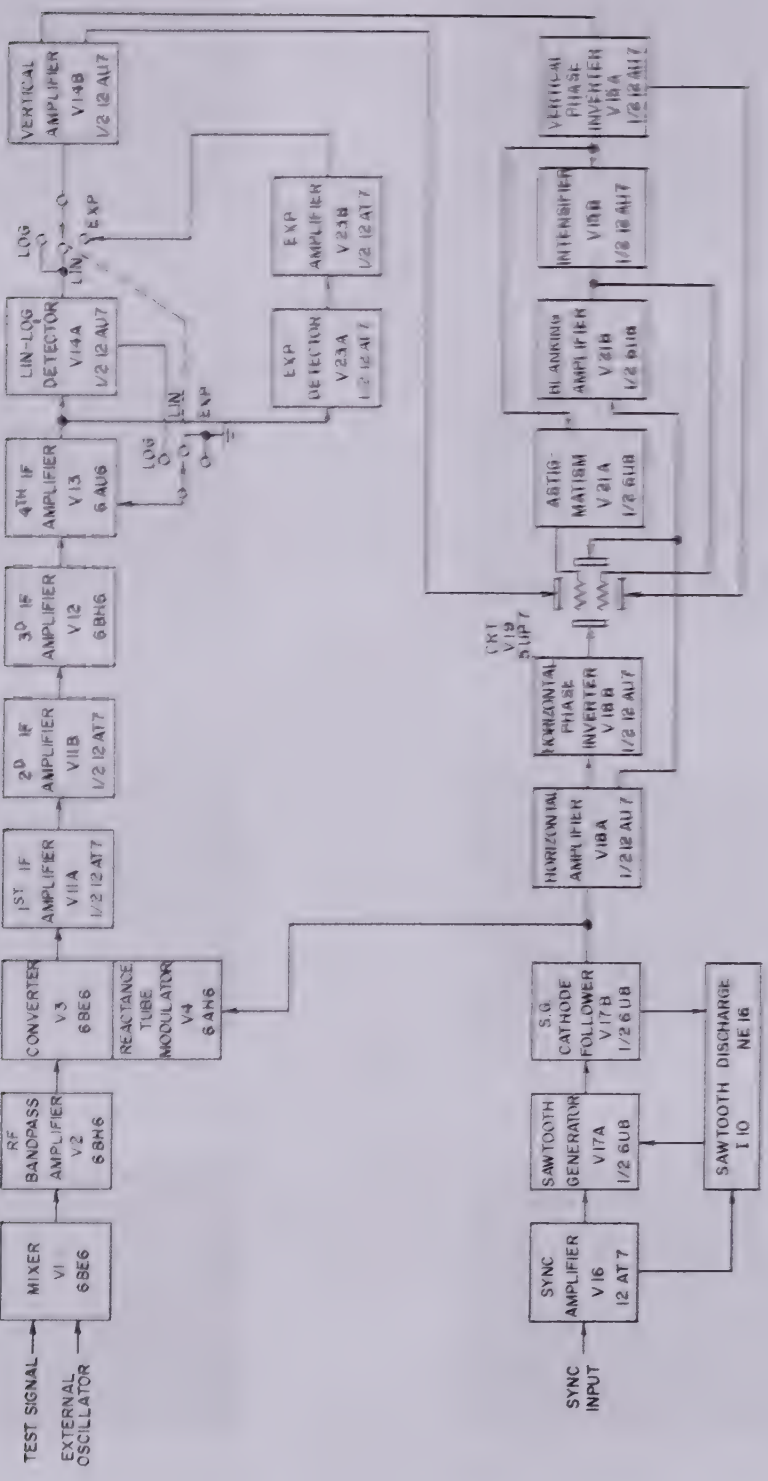

TEST SIGNAL
EXTERNAL OSCILLATOR
MIXER V1 6BE6
RF BANDPASS AMPLIFIER V2 6BH6
CONVERTER V3 6BE6
REACTANCE TUBE MODULATOR V4 6AN6
1ST IF AMPLIFIER V11A 1/2 12AT7
2D IF AMPLIFIER V11B 1/2 12AT7
3D IF AMPLIFIER V12 6BH6
4TH IF AMPLIFIER V13 6AU6
LIN-LOG DETECTOR V14A 1/2 12AU7
VERTICAL AMPLIFIER V14B 1/2 12AU7
EXP DETECTOR V23A 1/2 12AT7
EXP AMPLIFIER V23B 1/2 12AT7
LOG
LIN
EXP
SYNC AMPLIFIER V16 12AT7
SYNC INPUT
SAWTOOTH GENERATOR V17A 1/2 6U8
S.G. CATHODE FOLLOWER V17B 1/2 6U8
SAWTOOTH DISCHARGE I 10 NE 16
HORIZONTAL AMPLIFIER V18A 1/2 12AU7
HORIZONTAL PHASE INVERTER V18B 1/2 12AU7
CRT V19 5UP7
ABTIG MATISM V21A 1/2 6U8
BLANKING AMPLIFIER V21B 1/2 6U8
INTENSIFIER V19B 1/2 12AU7
VERTICAL PHASE INVERTER V18A 1/2 12AU7

Figure IV-1. Block Diagram, Model SB-8b.

CHAPTER IV - THEORY OF OPERATION

IV-1 INTRODUCTION

The Panalyzor is essentially an automatic-scanning heterodyne receiver which provides a visual display of signals present within a given band.

The Panalyzor is operated with an external signal generator or oscillator which "tunes in" the band to be observed. The first stage of the Panalyzor is an aperiodic mixer. Since there is no preselection and since a flat, broad band, amplifier follows the mixer, the relative heights of the signal indications will, within limits, coincide with the actual signal levels.

The Panalyzor consists basically of a broad band r-f amplifier, swept local oscillator and converter, variable selectivity intermediate-frequency amplifiers, detector, video amplifier, cathode-ray tube indicator, associated sweep circuits and an intensifier.

The swept oscillator progressively heterodynes in order of frequency with those signals appearing across the output of the broad band amplifier to produce a difference frequency which is passed and amplified by the intermediate-frequency section. The output voltage of the i-f section which is proportional to the amplitude of the scanned signal, is detected, amplified by the video section, and applied to the vertical deflection plates of the cathode-ray tube.

Oscillator sweep is obtained from a sawtooth modulated reactance tube circuit. A sawtooth generator supplies the necessary modulating voltage and also provides for horizontal sweep of the crt beam. For each discrete point on the horizontal axis of the crt there is a corresponding local oscillator frequency and consequently a corresponding signal frequency.

The intermediate-frequency section includes two variable selectivity stages. A ganged control is used to vary the bandwidth of these two stages. Also included is an i-f stage with circuit parameters which allow logarithmic amplification of signals. A detector, with circuit parameters which provide exponential amplification of signals is also provided. The output of the video section is applied to an intensifier tube as well as to the vertical deflection plates of the crt. An adjustable amount of a positive voltage output from the intensifier is impressed upon the intensity grid of the crt enabling signals to intensity modulate the crt beam.

IV-2 CIRCUIT DESCRIPTION

a. Signal Mixer, V1: This stage uses a 6BE6 pentagrid mixer. The test signals are applied to one control grid. The output of the external oscillator is applied to the second control grid. The function of the stage is to heterodyne the test signals with the external oscillator to produce a difference frequency which is equal to the input center frequency of the Panalyzor. Any gain derived from the stage is incidental.

b. R-f Bandpass Amplifier, V2: The function of this stage is to obtain a flat response across the scanned spectrum, and to provide image rejection. The output load of the signal mixer consists of a double tuned transformer T101 which is highly overcoupled and loaded resulting in a broad double-peaked response. Peaking frequencies are:

Type	Peaking Frequencies
T-200	400 KC and 600 KC
T-1000	4.7 MC and 5.3 MC

The voltage appearing across T101 is applied to the control grid of V2, a 6BH6 pentode amplifier. The output load of V2 is also an overcoupled double tuned transformer, T102, which has a double-peaked response. The approximate locations of the peaks are:

Type	Peaks
T-200	470 KC and 530 KC
T-1000	4.4 MC and 5.6 MC

Both T101 and T102 are permeability tuned. The overall response of the T101 and T102 combination is relatively flat over the specified bandpass region. This is illustrated in Figure IV-2.

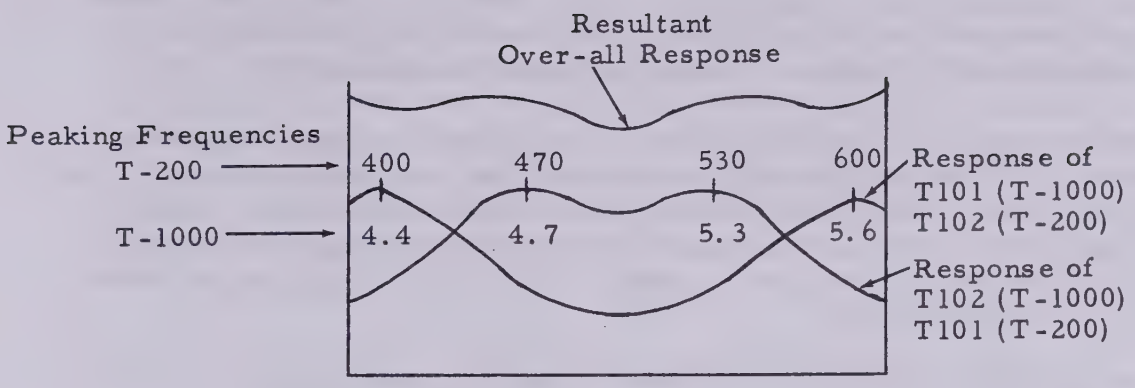


Figure IV-2. Overall Response of Panalyzor as determined by the Bandpass Characteristics of the Input (T101) and Output (T102) Transformers.

The GAIN control is incorporated in the cathode circuit of V2. This control varies the grid bias on the tube thus governing transconductance. Current from the B+ supply is bled through the GAIN control to provide a greater range of gain variation and permit cutting off plate current in V2. The plate circuit of V2 is connected to regulated B+. This insures that plate current variations will not cause undesirable reactions in other circuits as the GAIN control is manipulated.

c. Converter, V3: This stage uses a 6BE6 pentagrid converter. This tube serves as a local oscillator and also acts as a mixer to combine the output of the local oscillator with the output of the r-f bandpass amplifier. Oscillator and input signals are hetrodyned in the mixer to produce sum and difference terms of the input and oscillator frequencies. The difference frequency is selected and amplified by the i-f section. The difference frequency is the intermediate-frequency.

The oscillator is a grounded plate Hartley type. Grid #1 of the 6BE6 acts as the oscillator grid and Z101 constitutes the oscillator tank circuit.

The electron stream traveling from the cathode to plate of the converter tube is affected not only by grid #1 but also by grid #3 which is connected to T102, the r-f amplifier output transformer.

To eliminate the possibility of hum modulation, the heater of the converter V3, and reactance tube modulator V4, are operated on dc. Two 6.3 V power transformer windings are connected in series. Their output is full wave rectified and filtered. The resultant dc is applied to the two tubes connected in series. (V12, an i-f amplifier is wired in parallel with V3).

The oscillator is periodically tuned through a given range by the reactance tube modulator.

d. Reactance Tube Modulator V4: This tube is connected to the oscillator through a phase shifting network in such a manner that it becomes part of the oscillator tuned circuit. By varying the control grid voltage, the reactive current of the tube changes to swing the frequency of the oscillator. The controlling voltage variation, which is derived from a sawtooth voltage generator, is applied to the grid periodically. When the sawtooth voltage is zero, the oscillator is at its mean frequency.

The sawtooth on the reactor grid rises linearly from zero to a maximum positive voltage and then falls to a maximum negative value. From there it rises linearly to zero, completing one cycle. In coincidence with this the oscillator sweeps upward in frequency, then suddenly snaps back past the mean frequency to the minimum frequency and then sweeps back to the mean frequency. The extent of frequency excursion is determined by the amplitude of the applied sawtooth voltage. The SWEEP WIDTH control governs this amplitude and consequently controls the scanning width. The chassis mounted SWEEP LIMIT semi-adjustable control limits the sawtooth voltage between the SWEEP WIDTH control and the sawtooth source.

By controlling the bias on the reactance tube modulator, the mean frequency of the oscillator becomes adjustable. The CENTER FREQ control is actually a fine cathode bias control on the reactor tube. The chassis mounted CF PAD is a coarse bias adjustment.

e. I-F Section: The primary function of the intermediate-frequency section is the selection and amplification of a given difference frequency which appears at the output of the Converter. The design features include variable selectivity and selectable linear, logarithmic or exponential amplification.

To examine the general operation of the i-f section, the operation of the Type T-1000 may be considered. The intermediate-frequency of this instrument is 1500 KC, the oscillator excursion extends slightly on either side of the region between 6.0 MC and 7.0 MC while the r-f bandpass amplifier passes signal frequencies between 4.5 MC and 5.5 MC, the center being 5 MC. Figure IV-3 below illustrates these facts in relation to the calibrated indicator screen.

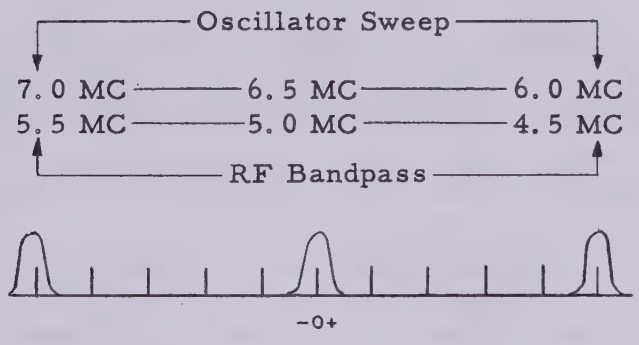


Figure IV-3. Relationship of r-f bandpass and oscillator sweep frequencies to input signals.

If it is assumed that signals are present at 4.5 MC, 5 MC and 5.5 MC, then as the oscillator starts its upward frequency sweep from slightly below 6 MC, it will heterodyne with each of the three signals to produce the following difference frequencies.

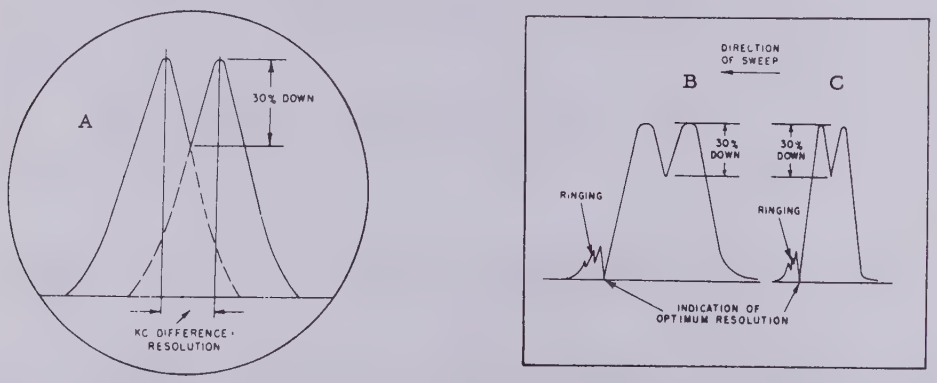
slightly below 1500 KC for the 4.5 MC signal
slightly below 1000 KC for the 5.0 MC signal
slightly below 500 KC for the 5.5 MC signal

But since the i-f section is sharply tuned to 1500 KC, only the 4.5 MC signal will appear as a significant voltage. The other difference products are so far removed from the 1500 KC resonance frequency that they are greatly attenuated by the i-f selective circuits. As the oscillator approaches 6 MC the i-f voltage for the 4.5 MC signal will rise and will for all practical purposes become a maximum when the oscillator is at 6 MC. The voltage then decreases as the oscillator swings upward from 6 MC.

Thus, only the 4.5 MC signal will produce an indication when the oscillator sweeps through 6 MC. By the same reasoning it can be seen that only the 5 MC signal will produce a pip when the oscillator passes through 6.5 MC.

The shape of the pip on the crt screen represents, to a degree, the response characteristic of the i-f section. At times, the test signals are so close in frequency (especially signals with many side bands) that these signals tend to merge on the screen of the crt. Merging of the signals is undesirable; thus it is necessary to separate, or resolve, the signals to simplify interpretation.

Resolution is defined as the frequency difference between the peaks of two signals when their curves merge at a point approximately 30 per cent below their maximum amplitudes. (See A, Figure IV-4).



A. Representation of Resolution.

B. Ringing effect indicating Optimum Resolution

Figure IV-4

Resolution is dependent upon three factors; the i-f bandwidth of the unit, the sweep rate, and the sweep width. These three factors are controlled by the front panel RESOLUTION control, the SWEEP RATE selector, and the SWEEP WIDTH control, respectively. It is possible to obtain resolution at various combinations of settings of these three controls. One particular combination of settings of these controls will give best possible (optimum) resolution.

Both B and C, Figure IV-4, indicate best resolution with the two test signals merging at 30 per cent below their maximum amplitudes. B, Figure IV-4, represents best resolution at a narrow sweep width, and C represents best resolution at a wide sweep width.

Best possible resolution is indicated when the first ringing pulse (that pulse nearest the signal) reaches the baseline of the trace. Ringing will appear only on the trailing edge of the signal. To see the ringing effect on the screen of the crt, set the VIDEO FILTER switch on the front panel to the OUT position.

To achieve maximum resolution for given sweep widths and rates, two variable selectivity i-f stages are incorporated. A twin triode V11 (12AT7) is common to both stages.

One section of V11 is coupled to the output of the converter through transformer Z102. The secondary coil of Z102 is tuned in part by the capacitance of the cable which connects Z102 to the 12AT7 grid. Both the plate and cathode circuits contain load resistors. The cathode load is shunted by a crystal in series with load coil Z103. A variable capacitor is connected to the junction of the crystal and load coil. The other side of the capacitor is attached to the plate load.

The inductance of the crystal load coil is adjusted so that, in conjuntion with various shunt capacities, its parallel resonant frequency is equivalent to the crystal series resonant frequency. The load coil at parallel resonance acts as a highly resistive impedance in series with the crystal, thus causing a broad response. To vary the response width, a potentiometer is shunted across part of the load coil.

As this shunt resistance is made smaller, the response width becomes narrower. The potentiometer is one section of the RESOLUTION control.

To neutralize crystal holder capacity effects the variable capacitor mentioned above applies a voltage to the crystal load coil which is equal and in phase opposition to the voltage applied through the holder capacity. The neutralizing capacitor is used to eliminate the rejection slot.

The i-f voltage appearing across the crystal load coil is applied to the second triode grid of the 12AT7, V11. The circuitry of this second section is similar to that of the first. Another load coil also contained in Z103 is used for the second crystal filter. The potentiometer across this coil, in conjunction with the potentiometer across the first load coil forms the RESOLUTION control.

A potentiometer shunted across the second load coil of Z103 and the second half of the RESOLUTION control is the chassis mounted BANDWIDTH LIMIT control. It is used to set the overall limit of the i-f bandwidth.

counteracts the bias, allowing passage of the crt beam. Operation of the INTENSIFIER control is described in Chapter III.

h. Astigmatism and Blanking Amplifiers (V21):
The output of the triode section of the 6U8, V21, sets the operating level of the second anode of the crt. A variable cathode bias resistor governs the output voltage. This is the ASTIGMATISM control. It is set to reduce de-focusing of the beam at different points within the limits of the face of the crt.

The input to the grid of the intensifier, V15, is also connected to the grid of the triode section of V21. The resultant output voltage reduces de-focusing when the INTENSIFIER is operated.

Sawtooth voltage from the plate of the First Horizontal Amplifier is connected to the grid of the pentode section of V21 through a differentiating network. The output of the blanking amplifier supplies a negative-going voltage pulse to the control grid of the crt. The duration of the pulse is approximately the same as that of the horizontal sawtooth retrace. This blanking of the brilliance of the crt beam suppresses visible traces during flyback time.

i. Sweep Circuits: The sawtooth sweep voltage is derived from the sweep generator V17, a 6U8 and I10, a NE16 neon lamp with a conductive coating. The pentode section of the 6U8 acts as a Miller type sweep generator. A resistor and capacitor in the grid circuit provide a time constant which controls the negative-going voltage on the grid. This change in grid voltage is amplified in the pentode section and is fed back 180° out of phase through the triode cathode follower section of the same tube. This amplified positive-going voltage tends to slow down the time constant, or rate of negative change, in the grid of the pentode section. This results in a linear, positive sawtooth voltage in the output of the cathode follower. When this voltage reaches a predetermined amplitude, I10 conducts, restoring the grid of the pentode section of the 6U8 to its beginning condition. (The conduction time for I10 is the flyback time of the sawtooth).

One section of a dual potentiometer in the crt negative voltage bleeder string governs the negative going voltage applied to the grid of the pentode section of V17. This negative-going voltage determines the amplification of the time constant. The other section of the dual potentiometer determines the resistive portion of the grid time constant of V17. These two sections of the dual potentiometer make up the SWEEP RATE control.

When the negative grid voltage of the pentode section of V17 is at a minimum, the amplification of the time constant will be the greatest. At the same time the second section of the dual potentiometer is at highest resistance or highest time constant. Rotation of the SWEEP RATE control in a clockwise direction results in a higher sweep rate. Fully clockwise = 60 cps. Fully counterclockwise = 1 cps.

In the CAL or LINE position of the CAL-SYNC SEL(ECTOR) switch, 6.3 volt 60 cps ac from the filament system is fed to the grid of the Sync Amplifier-Limiter, a dual triode 12AT7, V16.

The differentiated output of the Synch Amplifier is fed through the SYNC AMP(LITUDE) potentiometer to the conductive coating of I10. Voltage pulses appearing on this coating will electrostatically cause variations in the firing voltage of I10, the sweep discharge, or flyback tube. A pilot lamp, I2, is located adjacent to I10. The function of I2 is to maintain a constant ionization level in I10 by photo-electric effect, thereby maintaining a constant striking or firing voltage. (Note: If I2 is not lit, erratic operation of the sweep circuit may occur).

The EXT position of the CAL-SYNC SEL(ECTOR) permits synchronization with external voltage, which can be fed in through the EXT SYNC jack J103.

The sawtooth sweep voltage from the output of the sweep generator cathode follower is capacitively coupled to both the Horizontal Amplifier and the Reactance Tube Modulator. The LINE SIZE control is located in the input of the Horizontal Amplifier. The SWEEP WIDTH and SWEEP LIMIT controls are coupled after the LINE SIZE control to prevent changes in horizontal location of pips with line voltage fluctuations.

The horizontal amplifier, V18, one section of a 12AU7 twin triode, is direct coupled to one horizontal deflection plate of the crt indicator, to the horizontal phase inverter and to the blanking amplifier.

Coupling between the output of the horizontal amplifier and the first horizontal deflection plate is direct. Hence, the same dc voltage appears on the plate of the amplifier and on the deflection plate. A variable cathode bias and resistor governs the plate voltage of the amplifiers and consequently the horizontal position of the crt indication. This is the HORIZONTAL POSITION control.

The second section of the 12AU7 twin triode, V18 is the horizontal phase inverter. The output of the inverter, which is 180° out of phase with the input voltage, is direct coupled to the second or opposing horizontal deflection plate of the crt.

The FOCUS and BRILLIANCE controls are in the high voltage bleeder chain.

CHAPTER V - SERVICE AND MAINTENANCE

If trouble develops which cannot be corrected by following the procedures outlined in the following paragraphs, it is recommended that the instrument be returned to Panoramic Radio Products, Inc. for servicing. Before returning the instrument, fill out the Repair and Maintenance form bound in the rear of this Manual and send it to us. Upon receipt of this information our Service Department will send you service data or shipping instructions.

Upon receipt of shipping instructions, forward the instrument prepaid to the factory. If requested, an estimate of charges will be made before work begins.

This chapter is divided into five sections to facilitate its use in connection with adjustment, repair or alignment of the equipments.

Section V-1 contains a discussion of the semi-adjustable controls found on the chassis of the equipments.

Section V-2 is a guide to trouble shooting. The principal types of troubles that may be encountered are listed. For each trouble, the likely causes are indicated.

Section V-3 contains voltage and resistance charts.

Section V-4 is a complete factory alignment procedure.

Section V-5 is a list of replaceable parts.

V-1 SEMI-ADJUSTABLE CONTROLS

These controls are in circuits which seldom require adjustment. They are located on top of the chassis.

a. VERTICAL POSITION: If the baseline trace is not in line with the lowest horizontal grid line on the screen, adjust this control to obtain coincidence. If the baseline is not parallel with the grid line, the crt should be rotated. This requires loosening of the clamp around the crt socket and relaxation of the crt bezel screws so that pressure on the tube by the bezel is removed. Be sure that the power is off when adjusting the physical position of the crt.

The crt socket can then be rotated as required. In equipments supplied with a 5UP7 crt, the screen is held in place by detents in the bezel grommet. There is slight amount of play in this fit so that if exact lining up of the trace and grid is difficult through tube rotation the screen position may be changed a trifle.

b. LINE SIZE: The horizontal length of the trace is adjusted with this control. If the trace is excessively long, resolution will be adversely affected. If the trace is too short, the scanning width will be reduced. If adjustment is required, the LINE SIZE control should be set for a baseline length which extends from three quarters to one division on either side of the frequency scale extremities.

c. IF GAIN: Reserve gain is provided in the i-f section. When the overall gain is below that specified, set the front panel GAIN control to maximum, RESOLUTION completely clockwise, AMPLITUDE SCALE selector to LIN. Apply the specified sensitivity voltage to the equipment through the input cables (and isolating elements where applicable). Adjust the IF GAIN control for full scale deflection.

d. LOG SCALE ADJUSTMENT: This adjustment may be checked by feeding in a signal which causes a full scale deflection for LIN setting of the AMPLITUDE SCALE selector. Turn the selector to LOG. Increase the amplitude of the input signal by ten times. If this does not give a full scale deflection, rotate the LOG SCALE ADJUSTMENT potentiometer until full scale deflection is obtained.

e. LOG ZERO ADJUST: This adjustment may be checked by feeding in a signal which causes a full scale deflection for LIN setting of the AMPLITUDE SCALE selector. Turn the selector to LOG. The deflection should go down to 0 db. If it does not rotate the LOG ZERO ADJUST potentiometer until the deflection is at 0 db. It is important to note that procedures (d) and (e) must be repeated until the LOG SCALE is correct.

f. SWEEP LIMIT and CF PAD: See Alignment Procedure.

g. BANDWIDTH LIMIT: See step 18, I-F Alignment Procedure, Paragraph V-4b.

h. ASTIGMATISM: This adjustment may be checked by feeding in a signal which causes a full scale deflection. The BRILLIANCE control should be set to give a moderate trace on the screen.

The INTENSIFIER should be set fully counterclockwise. Adjust the ASTIGMATISM and FOCUS controls simultaneously while traversing the pip across the screen. The ASTIGMATISM control is at the correct setting when both the baseline and the pip are in sharp focus on all points of the screen. (Or best over-all focus is obtained).

V-2 TROUBLE SHOOTING

WARNING: When servicing the Analyzer or the power supply, be extremely careful of the exposed high voltages. Always disconnect the interconnecting cable between the Analyzer and the power supply and discharge capacitors C2 and C3 before doing any testing. With the high voltage off, potentials as great as 2,000 volts are still present in the Analyzer and the power supply.

a. Most of the parts in the Panalyzor are readily accessible and are replaced easily if found to be faulty. If the SWEEP RATE SELECTOR switch requires replacement, mark the wires connected to the switch with tags to avoid misconnection when the new switch is installed. Follow this practice whenever replacement requires the disconnection of numerous wires.

b. When a part is replaced in any r-f or i-f circuit, it must be placed exactly in the same position as the original part. A part which has the same electrical value but different physical size may cause trouble in high-frequency circuits. Give particular attention to proper grounding when replacing a part. Failure to observe these precautions may result in decreased gain or the possibility of oscillation in the circuit.

c. The following chart is supplied as an aid in locating trouble in the Analyzer and power supply. The chart lists the symptoms which the repairman observes, either visually or audibly, while making a few simple tests. The chart also indicates how to localize trouble quickly to a circuit stage or circuit element. Once the trouble has been localized to a stage or circuit, a tube check and voltage and resistance measurements of this stage or circuit should be ordinarily sufficient to isolate the defective part or parts. Normal voltage and resistance measurements are given in V-3, Voltage and Resistance Charts.

SYMPTOM	PROBABLE TROUBLE	CORRECTION
1. No illumination on the screen when POWER switch is turned to the ON position. Pilot lamp does not light.	AC power is not being supplied the power supply or the indicator.	Check interconnecting cables. Check for input voltage.
	Open fuse F1 or F2 in power supply.	Replace fuse. If it blows again, check filter capacitors C1 through C6 in power supply. Check all filter and bypass capacitors in analyzer.
	Transformer T1 defective.	Check transformer output voltages.
2. Indicator operates normally but pilot lamp does not light.	Pilot lamp or pilot lamp socket defective.	Replace pilot lamp. Check pilot lamp socket.
3. No illumination is observed on the screen of crt. Pilot lamp lights.	Improper adjustment of BRILLIANCE or FOCUS controls. Improper adjustment or HORIZONTAL POSITION or VERT. POSITION controls.	Adjust these controls. (Use the procedures given in Paragraphs II-3 and V-1.
	Failure of B+ or high-voltage supply.	Remove the power supply from its case and compare voltages measured between each terminal and the chassis with values shown in Paragraph V-3 (Voltage and Resistance Chart).
	Defective crt V19.	If no voltage or low or high B+ voltage is present check tube V101 and capacitors C1 through C6.
4. With the GAIN control turned completely counterclockwise, a dot or short line is observed on the screen but a horizontal baseline (horizontal sweep) is not obtained.	Faulty sweep stage.	Check tubes V17, V18, V101, and their tube socket resistances and voltages.
	Improper adjustment or LINE SIZE control	Adjust this control; use the procedure given in Paragraph V-1 b.

SYMPTOM	PROBABLE TROUBLE	CORRECTION
5. GAIN control turned completely counterclockwise, the horizontal baseline is obtained, but it is unstable in CAL and SYNC positions of the CAL SYNC SEL switch.	Horizontal oscillator circuit not synchronized. Faulty sweep stage.	Adjust the SYNC AMP control; use the procedure given in Paragraph II-3 b. 11. Check tubes V16, V17, and I10 and the voltages and resistances for the tube sockets.
6. Horizontal baseline trace appears normal, but no vertical deflection signal is observed when the GAIN control is tuned in a clockwise direction.	No input signals; amplitude of input signal is low; input signals are at an incorrect frequency.	Check r-f cables from the external oscillator andfrom the source of test signals. Check frequency of signals from external oscillator and test signal source.
7. With the SWEEP WIDTH control turned completely clockwise, the vertical deflection representing a 5 MC signal does not appear on the horizontal baseline at the zero line of the calibrated scale.	Improper adjustment of the CF PAD control, the CENTER FREQ. control, or the HORIZONTAL POSITION control.	Adjust these controls; use the procedures given in Paragraphs II-3 and V-1.
8. The frequencies of signals, as determined by their position on the horizontal baseline in reference to the calibrated scale, are not indicated accurately.	Improper alignment of the bandpass amplifier. Tube V1, V2, V3, V4 and V20 defective.	Perform the alignment procedures given in Paragraphs V-4 d. Check and replace if necessary.
9. Varying amplitude of a signal that is tuned across the length of the horizontal baseline.	Improper alignment of the bandpass amplifier. Network T101 or T102 defective.	Realign networks T101 and T102. Use the procedure given in Paragraph V-4 d. Check the dc resistance of the networks. Replace if necessary.
10. With the SWEEP WIDTH control set at its maximum clockwise position, the vertical deflection (representing a signal) does not appear as a peak, but rather as a shift in the baseline.	Defective reactance tube modulator stage.	Check tube V4. Check the tube socket voltages and resistances. Check the resistances of network Z101.

SYMPTOM	PROBABLE TROUBLE	CORRECTION
11. The length of the horizontal baseline does not cover the diameter of the screen although the controls are adjusted properly.	Defective stage in the horizontal sweep circuits.	Check tubes V17, V18, and V101. Check tube socket voltages and resistances of the above tubes.
12. The amplitude of the signals on the screen is low with the GAIN control of the indicator turned completely clockwise.	Input signals of very low magnitude, or improper connections of the r-f signals.	Check the input signals and the r-f cables.
	Improper alignment of the indicator.	Realign the indicator; use the procedure given in Paragraphs V-4 a, b, c, and d.
	Defective i-f stage.	Check tubes V1, V2, V3, V11, V12, V13, V14 and V15. Check the tube socket voltages and resistances.
	Improper adjustment of the IF GAIN control.	Adjust this control; use the procedure given in Paragraph V-1 c.
13. The screen of the crt contains burned spots.	Defective crt.	Slight adjustment of the VERT. POSITION control may allow the illumination to be observed in a screen area free from burned spots. If this is not possible or practical the crt must be replaced.
14. The indicator operates normally except that some vertical peaks are present along the baseline which do not move as the frequency of the external signal generator is varied.	Electrical interference, the frequency of which is synchronized with the sweep frequency of the indicator.	In many cases, the trouble may be traced to a nearby electrical appliance connected to the same power source as the indicator, or the trouble may be in the power source. Corrective power filters may be used in the event that the interference is caused by appliances. If the power source is the cause and a motor generator set is being used, corrective filters should be used.

SYMPTOM	PROBABLE TROUBLE	CORRECTION
15. Rotation of the GAIN control has no effect on the amplitude of the pip on the screen.	Capacitor C503 (T1K) C203 (T200) or resistor R506 (T1K) R206 (T200) or R507 (T1K) R207(T200) defective.	Check and replace if necessary.
16. No signals appear on the screen. Application of 4.5 mc to 5.5 mc signals to r-f input connector causes no pip or vertical elevation of the baseline. A strong 1.5 mc signal input causes a baseline elevation.	F-M oscillator stage inoperative. Tube V3 or V4 heater voltage is low.	Check tubes V3 and V4 and their tube socket voltages and resistances. Check capacitor C507 (T1K) C207 (T200) and replace if necessary. Check the dc resistance of network Z101. Check capacitor C620, resistors R634 (T1K) R334 (T200), R635 (T1K) R335 (T200) and rectifier CR1. Replace if necessary.
17. The signal image disappears from the screen at certain frequencies.	Tubes V3 or V4 or network Z101 defective.	Check tubes and the dc resistance of network Z101. Replace if necessary.
18. An input signal causes a vertical rise of the entire baseline rather than a pip.	SWEEP WIDTH control R33 misadjusted or defective. Capacitor C619 (T1K) C319 (T200) is shorted. Reactance tube modulator stage is defective.	Rotate control to its maximum clockwise position. Check this control for open or shorts and replace if necessary. Check and replace if necessary. Check tube V4, and network Z101, replace if necessary.
19. The CENTER FREQ. control does not center a 5 mc signal when the scanning width is reduced.	Network Z101 is misaligned. Tubes V3 or V4 resistors R629 (T1K) R329 (T200) R631 (T1K) R331 (T200) R632 (T1K) R332 (T200) defective. CF PAD potentiometer R630 (T1K) R330 (T200) misaligned or defective.	Realign this network; use the procedure given in Paragraph V-4 c. Check and replace if necessary. Realign this control; use the procedure of Paragraph V-4 c. Check this control for shorts and replace if necessary.

SYMPTOM	PROBABLE TROUBLE	CORRECTION
20. Resolution is unsatisfactory with the RESOLUTION control set for a broad pip as evidenced by an asymmetrical pip, the appearance of a rejection slot, or more than 20-percent fall of amplitude in changing the SWEEP WIDTH control from maximum counterclockwise position to maximum clockwise position.	IF GAIN control improperly adjusted.	Check by reducing the setting of the IF GAIN control to see if this corrects the difficulty. If not, restore the control to its original setting.
	Tube V11 is defective.	Check and replace if necessary.
	Transformer Z103 or capacitor C604 (T1K) C304 (T200) or C607 (T1K) C307 (T200) misaligned or defective.	Relign transformer and capacitor; use the procedure given in Paragraph V-4 b.
	Resistors R608A (T1K) R308A (T200) or R608B (T1K) R308B (T200) or crystal Y1 or Y2 defective.	Check and replace if necessary.
21. Resolution is unsatisfactory with the RESOLUTION control set for narrow i-f.	Defective Y1 or Y2.	Check by substitution and replace if necessary.
22. The log scale calibration is inaccurate (Paragraph V-1 d and e)	Tube V13 is defective.	Check tube and the tube socket voltages and resistances.
	LOG SCALE ADJUST and LOG ZERO ADJUST controls are misaligned.	Realign controls; use the procedure given in Paragraph V-1.
23. The VERT. POSITION control does not line up the baseline with the frequency scale.	Tube V14 or V15 is defective.	Check tube and the tube socket voltages and resistances.
	Resistor R11, R12, R47, R48, or R639 is defective.	Check for open or short and replace if necessary.
24. The tops of the pips on the screen of the crt flatten off below full-scale deflection.	Tube V14 or V15 is defective.	Check tubes and the tube socket voltages and resistances.
	Capacitor C6C is defective.	Check for leakage and replace if necessary.

SYMPTOM	PROBABLE TROUBLE	CORRECTION
25. Baseline not present but a dot appears on the screen at all sweep rates.	LINE SIZE control improperly adjusted.	Adjust this control; use the procedure given in Paragraph V-1.
	Tube V17 or V18 is defective.	Check tubes and the tube socket voltages and resistances.
	Resistor R24 or R35 is defective.	Check these parts and replace if necessary.
	Capacitor C11 or C12 is defective.	Check capacitors and replace if necessary.
	Tube V101 defective.	Check this tube and replace if necessary.
	No B+.	Check B+ output of power supply.
26. HORIZONTAL POSITION control does not center the baseline trace.	Tube V18 is defective.	Check tube and the tube socket voltages and resistances.
	Resistor R36, R37, R38 R39, R40, R42, R43, R44 R45 or R46 is defective.	Check and replace if necessary.
	Capacitor C13 is defective.	Check and replace if necessary.
27. The frequency scanning is nonlinear.	Capacitor C13 is defective.	Check and replace if necessary.
28. The screen of crt has low brilliance.	The BRILLIANCE control is misadjusted.	Turn control to its maximum clockwise position.
	CRT V19 is weak.	Replace V19.
	CR-1, CR-2 (in PS) defective.	Check and replace if necessary.
	Capacitor C2, C3 or C6 (in PS) is defective.	Check and replace if necessary.
	Resistor R2, R3, R4, R5 R6 (in PS) R52, R54, R56, R71 is defective.	Check and replace if necessary.
	Faulty connections between power supply and indicator.	Check the cable and plug connections between the power supply and indicator.

SYMPTOM	PROBABLE TROUBLE	CORRECTION
29. The screen of the crt has high brilliance at all positions of the BRILLIANCE control.	CRT faulty. R53 or C18 defective.	Replace CRT V19. Check and replace if necessary.

V-3 VOLTAGE AND RESISTANCE CHARTS

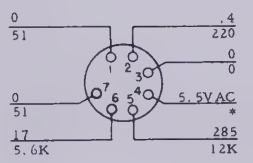
The voltage and resistance charts were made with analyzer section and power supply interconnected for normal operation.

All readings taken between point specified and chassis ground using an RCA VTVM Model WV-77A.

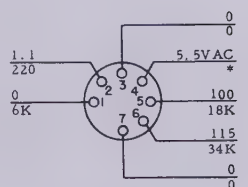
The following control positions were used:

BRILLIANCE	Normal
FOCUS	Normal
CAL-SYNC SEL	LINE
SYNC AMP	Set for correct sync
SWEEP WIDTH	1.0
SWEEP RATE	30 cps
RESOLUTION	1.0
CENTER FREQ	to center marker
AMPLITUDE SCALE	LIN
INTENSIFIER	Counterclockwise
GAIN	10
DIMMER	Clockwise
VIDEO FILTER	OUT

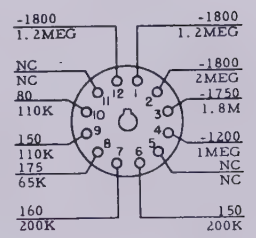
SIGNAL MIXER
V1
6BE6



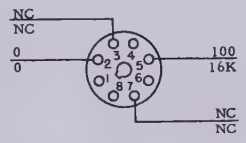
RF BANDPASS AMPLIFIER
V2
6BH6



CATHODE-RAY TUBE
V19
5UP7



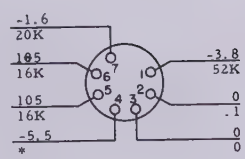
VOLTAGE REGULATOR
V20
OC3



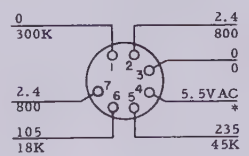
NOTES

1. VOLTAGE READINGS ABOVE LINE, RESISTANCE READINGS BELOW LINE.
2. ALL VOLTAGES ARE DC UNLESS OTHERWISE SPECIFIED.
3. ALL RESISTANCES ARE IN OHMS.
4. * INDICATES A VERY LOW RESISTANCE.
5. NC INDICATES NO CONNECTION.

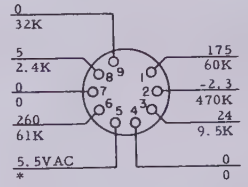
CONVERTER
V3
6BE6



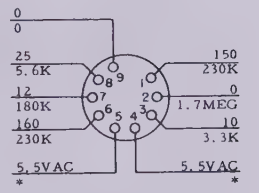
REACTANCE TUBE MODULATOR
V4
6AH6



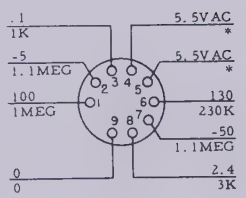
ASTIGMATISM - BLANKING AMPLIFIER
V21
6U8



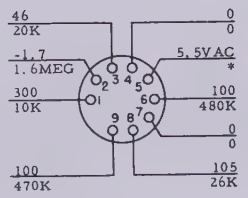
HORIZONTAL OUTPUT AND HORIZONTAL PHASE INVERTER
V18
12AU7



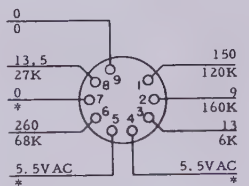
SYNC AMPLIFIER
V16
12AT7



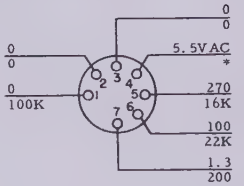
SWEEP GENERATOR AND CATHODE FOLLOWER
V17
6U8



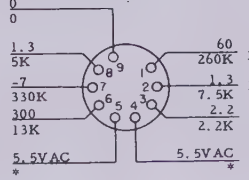
VERTICAL PHASE INVERTER AND INTENSIFIER
V15
12AU7



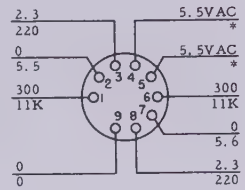
4TH IF (LIN-LOG) AMPLIFIER
V13
6AU6



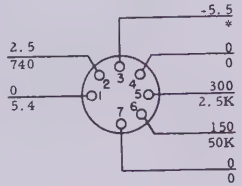
EXPONENTIAL DETECTOR AND EXPONENTIAL AMPLIFIER
V23
12AT7



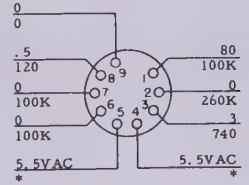
1ST AND 2ND CRYSTAL IF AMPLIFIER
V11
12AT7



3RD IF AMPLIFIER
V12
6BH6

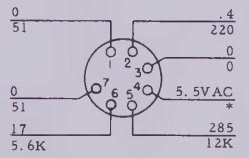


DETECTOR AND VERTICAL AMPLIFIER
V14
12AU7

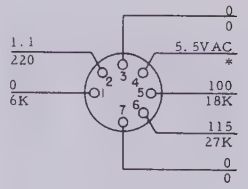


FRONT OF CHASSIS

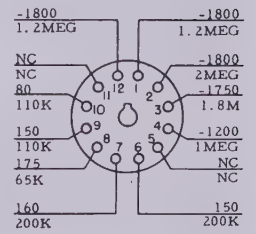
SIGNAL MIXER
V1
6BE6



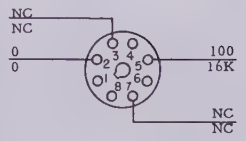
RF BANDPASS AMPLIFIER
V2
6BH6



CATHODE-RAY TUBE
V19
5UP7



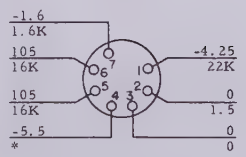
VOLTAGE REGULATOR
V20
OC3



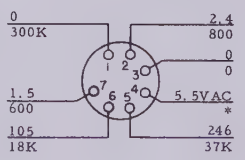
NOTES

1. VOLTAGE READINGS ABOVE LINE, RESISTANCE READINGS BELOW LINE.
2. ALL VOLTAGES ARE DC UNLESS OTHERWISE SPECIFIED.
3. ALL RESISTANCES ARE IN OHMS.
4. * INDICATES A VERY LOW RESISTANCE.
5. NC INDICATES NO CONNECTION.

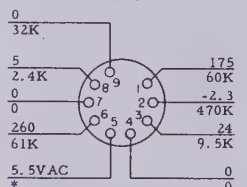
CONVERTER
V3
6BE6



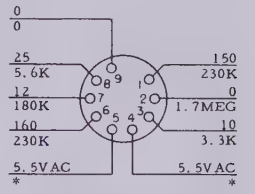
REACTANCE TUBE MODULATOR
V4
6AH6



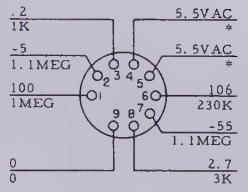
ASTIGMATISM - BLANKING AMPLIFIER
V21
6U8

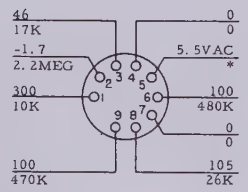


HORIZONTAL OUTPUT AND HORIZONTAL PHASE INVERTER
V18
12AU7

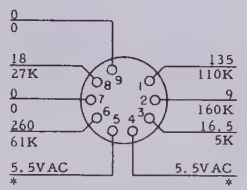


SYNC AMPLIFIER
V16
12AT7



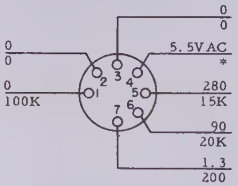


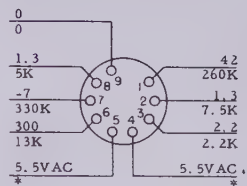
SWEEP GENERATOR AND CATHODE FOLLOWER
V17
6U8



VERTICAL PHASE INVERTER AND INTENSIFIER
V15
12AU7

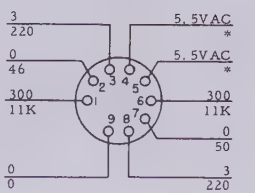
4TH IF (LIN-LOG) AMPLIFIER
V13
6AU6



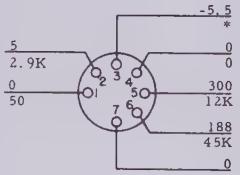


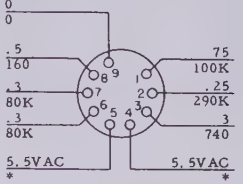
EXPONENTIAL DETECTOR AND EXPONENTIAL AMPLIFIER
V23
12AT7

1ST AND 2ND CRYSTAL IF AMPLIFIER
V11
12AT7



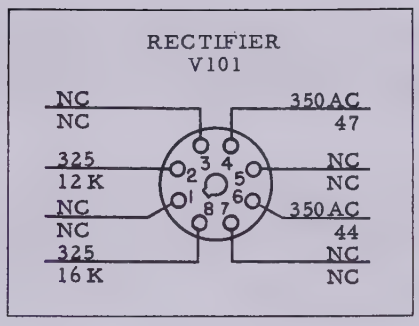
3RD IF AMPLIFIER
V12
6BH6





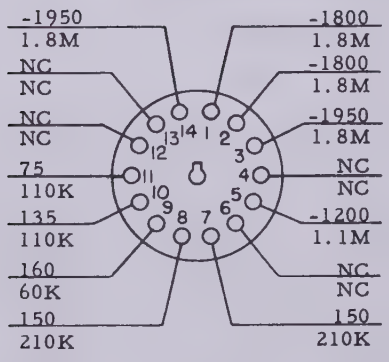
DETECTOR AND VERTICAL AMPLIFIER
V14
12AU7

FRONT OF CHASSIS



Power Supply, Model PS-8b

CATHODE-RAY TUBE
V19
5ADP7



V19 Voltages and Resistances
Z Modification

V-4. ALIGNMENT PROCEDURE

The following is a complete factory alignment procedure. It should be used only after touch-up alignment techniques have been tried and have failed to yield satisfactory results.

a. General

Transformers T101, T102, Z101, Z102, Z103, Z104 and Z105 are tuned by means of movable iron cores. Windings at the top of the coil are tuned with a hollow iron core which may be turned with the pin end of the aligning tool furnished.

The bottom windings may be tuned from either the top or the bottom of the transformer. In either case the screwdriver tip of the aligning tool is used. When the bottom core is approached from the top, the tool is inserted through the hollow top core and finally engaged in a slot in the top of the lower core. Allow the Panoramic equipment and necessary signal generator to "warm-up" for at least one-half hour before alignment is attempted.

b. I-F Amplifier Alignment

1. The frequencies involved in i-f alignment are:

Type	Input Center Freq.	IF
T-200	500 KC	226 KC
T-1000	5 MC	1.5 MC

(a) Set the front panel controls as follows:

RESOLUTION	completely clockwise
INTENSIFIER	completely counterclockwise
GAIN	maximum
AMPLITUDE SCALE	LIN
SWEEP RATE	30 cps
CAL-SYNC SEL	LINE
BRILLIANCE	bright trace as desired
FOCUS	sharp trace
CENTER FREQ	to marker
VIDEO FILTER	OUT
SWEEP WIDTH	completely clockwise

(b) Horizontal Adjustment

(1) Feed in a signal corresponding to the input center frequency specified above.

(2) Turn the SWEEP WIDTH control counterclockwise until base of the pip occupies 50 percent of the screen.

(3) Center the pip with the CENTER FREQ control.

(4) Turn the SWEEP WIDTH control to the maximum clockwise position.

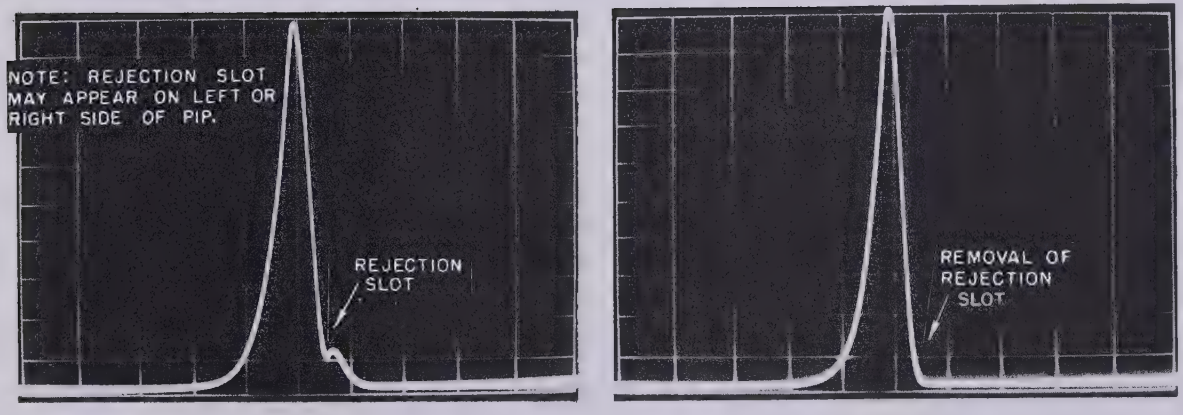
(5) Adjust the HORIZONTAL POSITION control to center the pip on the screen.

2. Connect an .01 mfd capacitor in series with the output of the signal generator and proceed as follows:

Step	Sig. Gen. Output	Sweep Width Control at	Signal Fed to	Procedure
1	I-f spec above (about 50,000 uv)	Minimum	Pin #1 V13 6AU6	Tune top and bottom cores of Z105 for maximum baseline rise. When either core is tuned for maximum deflection, no further tuning is required because windings are in parallel.
2	Same as above (1,000 uv)	Same as above	Pin #1 V12 6BH6	Tune top and bottom cores of Z104 for maximum baseline rise possible with each.
3	Same as above (2,500 uv)	Same as above	Pin #7 V3 6BE6	Tune top and bottom cores of Z102 for maximum baseline rise possible with each.

Step	Sig. Gen. Output	Sweep Width Control at	Signal Fed to	Procedure
4	Input Center Freq spec above (2,500 uv)	Maximum	Pin #7 V3 6BE6	Adjust the CENTER FREQ control and, if necessary, the CF PAD control to center the pip on the screen. Gradually reduce the sweep width, at the same time continuously readjusting the CENTER FREQ control to keep the pip on the screen until the base of the pip occupies approximately 25 percent of the frequency scale.
5	_____	Adjust continuously as required to keep the entire pip within screen limits.	_____	Mark the position of crystal Y1 in its socket. Holder capacity varies with position, therefore it will be important, when replacing the crystal, to preserve its orientation with respect to the socket. Remove crystal Y1 and place a 0.1 uf capacitor across the socket.
6	_____	_____	_____	A neutralizing capacitor is mounted near each crystal on the underside of the i-f strip. These capacitors are to be tuned with the screw driver end of the aligning tool furnished. Access holes will be found about halfway between the crystal sockets. Each capacitor tunes the crystal nearest to it. Turn the adjusting screw of the capacitor nearest crystal Y2 clockwise until it is just tight. Do not force.
7	_____	_____	_____	Reduce the sweep rate to approximately 1 cps by turning the SWEEP RATE control counterclockwise. Turn the RESOLUTION control counterclockwise until it is set as follows: Type T-200, at the 0.5 marker. Type T-1000, at the second marker from the fully counterclockwise end of the control rotation.

Step	Sig. Gen. Output	Sweep Width Control at	Signal Fed to	Procedure
				Adjust amplitude of the input signal, if necessary, to maintain full scale deflection. At this point pip should approximate the shape shown in Figure V-1 or its mirror image.
8	_____	_____	_____	Gradually rotate the trimmer screw of the capacitor nearest Y2 counter-clockwise approximately 2 turns, and note the change in pip shape. The rejection slot should sharpen and disappear on one side of the pip and approach from the other side.
9	_____	_____	_____	Reverse the rotation and choose a point where best pip symmetry is obtained and a rejection slot is not present. (Approximately halfway between the two positions at which the slot enters the pip from either side. (See Figure V-1).



A. Illustration of Rejection Slot

B. Illustration of Complete Rejection Slot Removal

Figure V-1. Crystal Rejection Slot Removal

Step	Sig. Gen. Output	Sweep Width Control at	Signal Fed to	Procedure
10	_____	_____	_____	Reset the SWEEP RATE control to 30 cps. Turn RESOLUTION control fully clockwise. Adjust amplitude of input signal, if necessary, to maintain full scale deflection. Tune the top core of Z103 for a minimum height and a broadest pip. Note that as the core is moved from one end of its range to the other, the pip will broaden and decrease in amplitude until a condition of minimum height and broadest pip is reached. Continued rotation will cause the pip to sharpen and increase in amplitude. (As the pip decreases in amplitude it may be necessary to increase the amplitude of the input signal to maintain a readable deflection on the screen).
11	_____	_____	_____	Check for correct rejection slot removal by adjusting sweep width until pip base occupies approximately 25 percent of the screen baseline. Set the input amplitude for a full-scale deflection. Increase input amplitude by ten times. Set SCALE SELECTOR to LOG. If the pip is not full-scale, set the LOG SCALE ADJ. for a full-scale pip. Pip should remain approximately symmetrical and no rejection slot should appear. If it does appear, readjust trimmer slightly to remove it and retune as in step 10. Reduce the input amplitude 10 times and set SCALE SELECTOR to LIN.

Step	Sig. Gen. Output	Sweep Width Control at	Signal Fed to	Procedure
12	_____	_____	_____	Remove the 0.1 uf capacitor placed across the crystal socket and replace crystal Y1 in its socket in the same orientation it has prior to removal.
13	_____	_____	_____	Mark the position of Y2 in its socket. Remove crystal Y2 and place a 0.1 uf capacitor across the socket. Repeat the procedure given in steps 6 through 11 using capacitor nearest crystal Y1 and the bottom core of Z103.
14	_____	_____	_____	Remove the 0.1 uf capacitor from empty socket and replace crystal Y2 in the same orientation it has prior to removal. Repeat step 11 with both crystals installed but omit reference to step 10. If trimmer adjustment is required, make small gradual changes in the trimmer settings. If there is no change when adjusting one of the trimmers, restore it to its original setting and adjust the other trimmer.
15	_____	_____	_____	Retune the top core of Z103 for a minimum symmetrical response curve of the pip. Refer to step 10 for the results of tuning the core.
16	_____	_____	_____	Turn the RESOLUTION control counterclockwise until the pip is reduced 30 percent. Retune the top and bottom cores of Z105, Z104, and Z102 for maximum pip height.

Step	Sig. Gen. Output	Sweep Width Control at	Signal Fed to	Procedure
17	_____	_____	_____	Set the RESOLUTION control fully clockwise and repeat step 15.
18	_____	_____	_____	Adjust BANDWIDTH LIMIT control for the broadest (without double peak) symmetrical peak possible without more than a 20 percent drop in amplitude as the SWEEP WIDTH control is changed from a maximum counterclockwise position to a maximum clockwise position.

c. F-M Oscillator Alignment

The following adjustments are a series of approximations, which are narrowed down until the desired results are obtained. During the entire procedure the signals are applied through the r-f cable and where applicable with the proper isolating element at the end of the cable.

The frequencies involved are:

Model	Type	Input Center Frequency	High Freq. Alignment	Low Freq. Alignment
SB-8b	T-200	500 KC	600 KC	400 KC
	T-1000	5 MC	5.5 MC	4.5 MC

1. Low Frequency Alignment

(a) Feed in a signal as shown under Low Frequency Alignment in the chart above.

(b) With SWEEP LIMIT and SWEEP WIDTH set for maximum, tune Z101 so that the deflection on the crt screen appears at the extreme left calibration.

2. Center Frequency Alignment

(a) Feed in a signal as shown under Center Frequency Alignment in the chart above.

(b) With the SWEEP WIDTH control at maximum, set the CENTER FREQ. control on the marker.

(c) Keeping the pip on center by adjusting Center Frequency CF PAD, reduce the SWEEP WIDTH until this control is almost at minimum.

(d) Return the SWEEP WIDTH control to full clockwise position. Center the pip with the Horizontal Position Control.

3. High Frequency Alignment

(a) Feed in a signal as shown under High Frequency Alignment in the chart on Page 72, Paragraph c.

(b) Reduce the SWEEP LIMIT until the deflection on the crt screen appears at the extreme right calibration.

4. Check on Overall Alignment

(a) Feed in a signal as shown under Low Frequency Alignment in the chart; if the deflection appears at the extreme left calibration, then the f-m oscillator is aligned.

(b) However, if this does not occur, repeat the Low Frequency Alignment, Center Frequency Alignment and High Frequency Alignment. Continue to narrow down by repeating these steps until the desired results are obtained.

SUGGESTION: In repeating the Low Frequency Alignment if the deflection appears to the right or left of the extreme right calibration, it should be moved the same distance to the other side of the calibration by tuning Z101.

d. R-F Alignment

The r-f transformers used in this equipment have sliders. This makes it possible to adjust the spacing between the primary and secondary so as to obtain the proper frequency separation between the peak frequencies.

If the frequency separation is correct, then it is only necessary to trim the cores of two r-f transformers until the desired flatness is obtained. If the frequency separation is not correct, the full alignment procedure must be used.*

1. R-F Alignment, Type T-200
   Set the AMPLITUDE SCALE Selector to LIN, CENTER FREQ for a centered 500 KC pip and SWEEP WIDTH at maximum. This alignment requires a "cut and try" method.

   The frequency response of the section is determined by feeding in constant amplitude signals, at various frequencies, over the r-f band of the equipment.

   (a) First Align the interstage transformer T102.

   (1) Make the spacing between the primary and secondary windings approximately 1/4".

   (2) Using a .01 mfd coupling capacitor, feed a 500 KC signal to the plate of V2 (pin #5). Tune the secondary bottom core) for a peak deflection at the center of the screen.

   (3) Apply a 530 KC signal to the grid of V2 (pin #1). Tune the primary (top core) for a peak deflection.

   (4) Applying the signal to grid of V2, vary the signal generator frequency over the r-f band of the equipment noting the frequency separation between the high and low frequency peaks as read on the screen of the equipment. The peaks should appear at 530 KC and at 470 KC.

   If the frequency separation is greater than specified, increase the coil spacing.

   If the frequency separation is less than specified, decrease the coil spacing.

   (5) Repeat steps (2), (3) and (4) until peak deflections and the proper frequency separation are obtained.

* The sliders have been waxed down to prevent movement. If it is necessary to change the position of the sliders, the waxing must be removed. Upon completion of the alignment procedure re-wax the coils to prevent movement.

(b) Then align the input transformer T101.

(1) In order to see the response characteristic of T101, it is first necessary to load down the primary and secondary of T102. For this purpose use resistors of approximately 10 K ohms clipped across both the primary and secondary of T102.

(2) Make the spacing between the primary and secondary windings approximately 1/16".

(3) Connect the signal generator to lug 1 of T101 and set the frequency to 500 KC. Tune the secondary (bottom core) for a peak deflection at the center of the screen.

(4) Now apply a 600 KC signal to one of the input connectors, through one of the input cables. Adjust the primary (top core) for maximum deflection.

(5) Vary the signal generator frequency over the r-f band of the equipment. Note the frequency separation between the high and low frequency peaks as read on the screen. The peaks should appear at 600 KC and at 400 KC.

If the frequency separation is greater than specified, increase the coil spacing.

If the frequency separation is less than specified, decrease the coil spacing.

(6) Repeat steps (3), (4) and (5) until peak deflections and the proper frequency separation are obtained.

(7) Remove the loading resistors across T102 used in steps (a) through (f).

(c) Then adjust the cores of the two r-f transformers for proper flatness as follows:

NOTE: When performing a complete r-f alignment, i.e., including (a) and (b) above, only steps (5) to (7) need be followed. If the frequency separation of the peaks is correct and only an adjustment of the cores to obtain proper flatness is being made, then steps (1) to (7) must be followed.

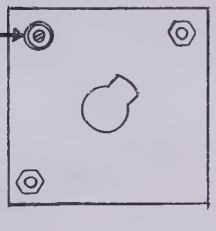
Step	Sig. Gen. Output	Transformer Tuned	Signal Fed to	Procedure
(1)	470 KC	T102	Pin #1 of V2, 6BH6	Tune bottom core (secondary) for a maximum pip deflection.
(2)	530 KC	T102	Pin #1 of V2, 6BH6	Tune top core (primary) for a maximum pip deflection.
(3)	400 KC	T101	Input Connector	Tune bottom core (secondary) for a maximum pip deflection.
(4)	600 KC	T101	Input Connector	Tune top core (primary) for a maximum pip deflection.
(5)	400 KC then 600 KC	T102	Input Connector	If the 400 KC pip is taller than the 600 KC pip, adjust for equal amplitude by trimming the bottom core clockwise and the top core counterclockwise. On the other hand if the 600 KC pip is the taller of the two, trim the bottom core counterclockwise and the top core clockwise.
(6)	400 KC 500 KC 600 KC	T102	Input Connector	If the 400 KC and 600 KC pips are taller than the 500 KC pip, trim the top and bottom cores clockwise. If they are lower, trim both cores counterclockwise.
(7)	------	------	------	Repeat (5) and (6) until response flatness is within ±5%.

2. R-F Alignment, Type T-1000
Set the SCALE SELECTOR on LIN, SWEEP WIDTH at maximum and CENTER FREQ for a centered 5 MC pip.

All adjustments are made from the top of the can.

Step	Sig. Gen. Output	Transformer Tuned	Signal Fed to	Procedure
(1)	5.6 MC	T102	Pin #1 of V2, 6BH6	Turn the core of the overcoupling choke so that no threads appear outside the can. Tune top core (primary) and bottom core (secondary) for a maximum vertical pip.
(2)	4.4 MC	T102	Pin #1 of V2, 6BH6	Tune overcoupling coil for a maximum vertical pip. Do not turn the core so far in a clockwise position that it cannot be turned in a counterclockwise direction.
(3)	5.6 MC	T102	Pin #1 of V2, 6BH6	Repeat (1)
(4)	4.4 MC	T102	Pin #1 of V2, 6BH6	Repeat (2)
(5)	5.3 MC	T101	Input Jack	Turn the core of the overcoupling coil so that no threads appear outside the can. Tune top core (primary) and bottom core (secondary) for a maximum vertical pip.
(6)	4.7 MC	T101	Input Jack	Tune overcoupling coil for a maximum vertical pip.

overcoupling coil



Top of can applies to both T101 & T102

Step	Sig. Gen. Output	Transformer Tuned	Signal Fed to	Procedure
(7)	5.0 MC	----------	Input Jack	Vary GAIN control until a deflection 1.0 is reached on the LIN scale on the screen.
(8)	5.3 MC	T101	Input Jack	Tune the bottom core (secondary) until a deflection of 1.0 is reached on the LIN scale. Use top core if necessary.
(9)	5.0 MC	----------	Input Jack	Repeat (7)
(10)	5.3 MC	T101	Input Jack	Repeat (8), if bottom core (secondary) does not give the necessary results, use the top core (primary) until a deflection of 1.0 is reached on the LIN scale.
(11)	5.0 MC	----------	Input Jack	Repeat (7)
(12)	4.7 MC	T101	Input Jack	Tune overcoupling coil until a deflection of 1.0 is reached on LIN scale.
(13)	5.0 MC	T101	Input Jack	Repeat (7)
(14)	5.3 MC	T101	Input Jack	Repeat (10)
(15)	5.0 MC	----------	Input Jack	Repeat (7)
(16)	4.7 MC	T101	Input Jack	Repeat (12)
(17)	5.0 MC	----------	Input Jack	Repeat (7)

Step	Sig. Gen. Output	Transformer Tuned	Signal Fed to	Procedure
(18)	--------	----------	------	Repeat steps (14) - (17) until a flatness of approximately ±7% is reached.

NOTE: Signal input level should be kept constant throughout steps (7) - (18).

SENSITIVITY: Set the controls of the equipment as indicated in Paragraph V-4.b.1(a). Feed in a signal of amplitude as listed in Paragraph I-5 for the direct sensitivity of the equipment and of frequency as listed in Paragraph I-5 for input Center Frequency of the equipment. This signal is fed in at the upper input jack. Set the IF GAIN control for full scale pip deflection.

V-5. LIST OF REPLACEABLE PARTS

a. This list is divided into two sections. The first section covers the Analyzer proper, the second covers the Power Supply.

b. In the case where an item appears more than once in a section, the total quantity per section is listed only once in the "Number in Set" column. It is listed the first time the item appears in each section.

c. A list of the Manufacturers Code Letters used in this list is given on Page 110.

d. In some cases values, ratings and source (manufacturer) shown are nominal and variations may be found. Satisfactory replacement may be made with either the listed component or an exact replacement for the part removed from the equipment.

When ordering parts from the factory, always include the following information.

1. Instrument Model Number
2. Serial Number
3. Circuit Reference Symbol
4. Panoramic Part Number
5. Description of Part(s)

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
C1		Capacitor: fixed, paper tubular molded plastic .01 uf, 600 V Pan Part CT-1038-1	BD 6TM-S1	7		
C2		Capacitor: fixed, paper, tubular molded plastic .047 uf, 400 V Pan Part CT-1285-1	BD 4TM-S47	1		
C3		Capacitor: fixed, foil mica 2700 uuf, ±10% Pan Part CM30B272K	AM CM30 B272K	1		
C4		Capacitor: fixed, silver mica 10 uuf, ±5% Pan Part CM20C100J	AM CM20C 100J	1		
C5		Capacitor: fixed, paper, tubular molded plastic .03 uf, 600 V Pan Part CT-2010-1	BD 6TM-S3	1		
C6 A, B, C, D		Capacitor: electrolytic, twist 4 x 20 uf, 450 V Pan Part CE34X200R-1	BH DFP	1		
C7		Capacitor: fixed, ceramic, disc .01 uf, 500 V Pan Part CC-2003-17	AC 36-103W	9		
C8		Capacitor: fixed, ceramic, disc .01 uf, 500 V Pan Part CC-2003-17	AC 36-103W			
C9		Capacitor: fixed, ceramic, disc .01 uf, 500 V Pan Part CC-2003-17	AC 36-103W			
C10		Capacitor: fixed, silver mica 5100 uuf, ±5% Pan Part CM35C512J	AM CM35C	1		

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
C11		Capacitor: fixed, silver mica 91 uuf, ±5% Pan Part CM20C910J	AM CM20 C910J	1		
C12		Capacitor: fixed, paper, tubular molded plastic .02 uf, 400 V Pan Part CT-2073-1	BH 109P 22304	1		
C13		Capacitor: fixed, paper, oil-filled, cylindrical, screw neck mounting 8 uf, 600 V Pan Part CP41C1XF805K-7	AR 6GA 800	1		
C14		Capacitor: fixed, silver mica 24 uuf, ±5% Pan Part CM20C240J	AM CM20 C240J	1		
C15		Capacitor: fixed, paper, tubular oil-filled axial leads .03 uf, 3000 V Pan Part CT-2104-3	AA 3089 M	2		
C16		Capacitor: fixed, paper, tubular molded plastic .1 uf, 400 V Pan Part CT-2011-10	BC 330 401	4		
C17		Capacitor: fixed, silver mica 510 uuf, ±5% Pan Part CM20C511J	AM CM20 C511J	2		
C18		Capacitor: fixed, paper, tubular oil-filled, axial leads .03 uf, 3000 V Pan Part CT-2104-3	AA 3089 M			
C19		Capacitor: fixed, ceramic, disc .01 uf, 500 V Pan Part CC-2003-17	AC 36- 103W			

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
C21		Capacitor: fixed, silver mica 1000 uuf, ±5% Pan Part CM25C102J	AM CM25 C102J	1		
C22		Capacitor: fixed, paper, tubular molded plastic .1 uf, 400 V Pan Part CT-2011-10	BC 330 401			
C25		Capacitor: fixed, silver mica 75 uuf, ±5% Pan Part CM20C750J	AM CM20 C750J	1		
C26		Capacitor: fixed, paper, tubular molded plastic .25 uf, 400 V Pan Part CT-2024-4	AI 4P25	1		
C28		Capacitor: electrolytic, twist-lock 2000 uf, 15 V Pan Part CE31X202E-1	BD TVL- 1168	1		
C29		Capacitor: fixed, paper, tubular molded plastic .47 uf, 200 V Pan Part CT-2075-1	BD 2TM- P47	1		
C500		Capacitor: fixed, ceramic, disc .01 uf, 500 V Pan Part CC-2003-17	AC 36- 103W			
C501		Capacitor: fixed, ceramic, disc .01 uf, 500 V Pan Part CC-2003-17	AC 36- 103W			
C502		Capacitor: fixed, ceramic, disc .01 uf, 500 V Pan Part CC-2003-17	AC 36- 103W			

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
C503		Capacitor: fixed, paper, tubular molded plastic .1 uf, 400 V Pan Part CT-2011-10	BC 330 401			
C504		Capacitor: fixed, ceramic, disc .01 uf, 500 V Pan Part CC-2003-17	AC 36- 103W			
C505		Capacitor: fixed, ceramic, disc .01 uf, 500 V Pan Part CC-2003-17	AC 36- 103W			
C506		Capacitor: fixed, paper, tubular molded plastic .1 uf, 400 V Pan Part CT-2011-10	BC 330 401			
C507		Capacitor: fixed, paper, tubular molded plastic .01 uf, 600 V Pan Part CT-1038-1	BD 6TM- S1			
C601 A, B, C		Capacitor: fixed, paper, oil-filled, channel type 3 x .1 uf, 600 V, ±20% Pan Part CP69B5EF104V-5	AO 7710- BRN	2		
C602		Capacitor: fixed, silver mica 15 uuf, ±5% Pan Part CM20C150J	AM CM20 C150J	2		
C604		Capacitor: variable, dual padder mica dielectric per section 7.5 uuf -80 uuf Pan Part CV-2032	AM 502	2		
C605		Capacitor: fixed, silver mica 510 uuf, ±5% Pan Part CM20C511J	AM CM20 C511J			

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
C607		Capacitor: variable, dual padder mica dielectric per section 7.5 uuf -80 uuf Pan Part CV-2032	AM 502			
C608		Capacitor: fixed, silver mica 15 uuf, ±5% Pan Part CM20C150J	AM CM20 C150J			
C609		Capacitor: fixed, paper, tubular molded plastic .01 uf, 600 V Pan Part CT-1038-1	BD 6TM-S1			
C610		Capacitor: fixed, paper, tubular molded plastic .01 uf, 600 V Pan Part CT-1038-1	BD 6TM-S1			
C611		Capacitor: fixed, paper, tubular molded plastic .01 uf, 600 V Pan Part CT-1038-1	BD 6TM-S1			
C612		Capacitor: fixed, silver mica 100 uuf, ±5% Pan Part CM20C101J	AM CM20 C101J	2		
C613		Capacitor: fixed, silver mica 270 uuf, ±5% Pan Part CM15E271J	AM CM15 E271J	2		
C614		Capacitor: fixed, paper, tubular molded plastic .01 uf, 600 V Pan Part CT-1038-1	BD 6TM-S1			
C615		Capacitor: fixed, silver mica 470 uuf, ±5% Pan Part CM20C471J	AM CM20 C471J	2		

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
C616		Capacitor: fixed, paper, tubular molded plastic .01 uf, 600 V Pan Part CT-1038-1	BD 6TM-S1			
C617		Capacitor: fixed, silver mica 100 uuf, ±5% Pan Part CM20C101J	AM CM20 C101J			
C618 A, B, C		Capacitor: fixed, paper, oil-filled, channel type 3 x .1 uf, 600 V, ±20% Pan Part CP69B5EF104V-5	AO 7710-BRN			
C619		Capacitor: fixed, silver mica 270 uuf, ±5% Pan Part CM15E271J	AM CM15 E271J			
C620		Capacitor: fixed, silver mica 240 uuf, ±5% Pan Part CM20C241J	AM CM20 C241J	1		
C621		Capacitor: fixed, silver mica 750 uuf, ±5% Pan Part CM20C751J	AM CM20 C751J	1		
C622		Capacitor: fixed, paper, wax impregnated .25 uf, 400 V Pan Part CT-2021-1	BD 68P22	1		
C623		Capacitor: fixed, silver mica 470 uuf, ±5% Pan Part CM20C471J	AM CM20 C471J			
C624		Capacitor: fixed, tubular, ceramic, axial leads 6.8 uuf, ±5% Pan Part CC-2083-15	BE Type GA	2		
C625		Capacitor: fixed, ceramic axial leads 6.8 uuf, ±5% Pan Part CC-2083-15	BE Type GA			

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
CR1		Selenium Rectifier, Bridge Type Pan Part CR-2010	BA 16S1B 1S1G	1		
CR2		Germanium Diode IN81 Pan Part CR-IN81	BA IN81	1		
EPJ2		Cable Clamp Pan Part J-2004	AD MS305 7-16	2		
EPJ10		Cable Clamp Pan Part J-2004	AD MS305 7-16			
I1		Pilot Lamp, miniature bayonet 6.3 V, 10.25A Pan Part B-1007	AK 47	2		
I2		Pilot Lamp, miniature bayonet 6.3 V, 10.25A Pan Part B-1007	AK 47			
I10		Neon Lamp, double-contact bayonet, special 67 1/2 VDC, 1/4 Watt Pan Part B-2026-M	AX B-202 6M	1		
J10		Box mounting receptacle, male 14-contact-solid shell Pan Part P-2006	AD MS- 3102 A-28- 2P	1		
J101		Receptacle, Type N, MIL. No. UG-58/U Pan Part J-1061	AD 82-24	2		
J102		Receptacle, Type N, MIL. No. UG-58/U Pan Part J-1061	AD 82-24			

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
J103		Receptacle: single contact, female Pan Part J-2010	AD 31-003	1		
L501		Choke: R-F ferrite core 2.5 Mh Pan Part L-2019	AW 6302	1		
L601		Choke: R-F insulated .47 uh, ±10% Pan Part L-2001	AS CLA 72-47-R47-10-0	1		
P101		Plug, Type N, MIL type UG-21B/U Pan Part P-1061	AD 82-61	2		
P102		Plug, Type N, MIL type UG-21B/U Pan Part P-1061	AD 82-61			
R1		Resistor: fixed, composition 620 ohms, ±5%, 1/2 W Pan Part RC20BX621J	AC EB-6215	1		
R2		Resistor: fixed, composition 120 ohms, ±5%, 1/2 W Pan Part RC20BX121J	AC EB-1215	1		
R4		Resistor: fixed, composition 4.7 megohms, ±5%, 1/2 W Pan Part RC20BX475J	AC EB-4755	1		
R5		Resistor: fixed, composition 1 megohm, ±5%, 1/2 W Pan Part RC20BX105J	AC EB-1055	4		
R6		Resistor: fixed, composition 1.2 megohms, ±5%, 1/2 W Pan Part RC20BX125J	AC EB-1255	1		

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
R7		Resistor: fixed, composition 220,000 ohms, ±5%, 1/2 W Pan Part RC20BX224J	AC EB-2245	9		
R8		Resistor: fixed, composition 160,000 ohms, ±5%, 1/2 W Pan Part RC20BX164J	AC EB-1645	1		
R9		Resistor: fixed, composition 5,600 ohms, ±5%, 1/2 W Pan Part RC20BX562J	AC EB-5625	3		
R10		Resistor: fixed, composition 27,000 ohms, ±5%, 1/2 W Pan Part RC20BX273J	AC EB-2735	1		
R11		Resistor: variable, composition linear 500,000 ohms, ±10%, 2 W Pan Part RVA504AQ-2J	AC JU-5041	3		
R12		Resistor: fixed, composition 68,000 ohms, ±5%, 1 W Pan Part RC32BX683J	AC GB-6835	1		
R13		Resistor: variable, composition linear 500,000 ohms, ±10%, 2 W Pan Part RVA504AQ-2J	AC JU-5041			
R14		Resistor: fixed, composition 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AC EB-1045	5		
R15		Resistor: fixed, composition 1 megohm, ±5%, 1/2 W Pan Part RC20BX105J	AC EB-1055			
R16		Resistor: fixed, composition 1,000 ohms, ±5%, 1/2 W Pan Part RC20BX102J	AC EB-1025	2		

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
R17		Resistor: fixed, composition 1 megohm, ±5%, 1/2 W Pan Part RC20BX105J	AC EB-1055			
R18		Resistor: fixed, composition 220,000 ohms, ±5%, 1/2 W Pan Part RC20BX224J	AC EB-2245			
R19		Resistor: fixed, composition 100 ohms, ±5%, 1/2 W Pan Part RC20BX101J	AC EB-1015	3		
R20		Resistor: fixed, composition 1 megohm, ±5%, 1/2 W Pan Part RC20BX105J	AC EB-1055			
R21		Resistor: fixed, composition 3,000 ohms, ±5%, 1/2 W Pan Part RC20BX302J	AC EB-3025	1		
R22		Resistor: variable, composition linear 50,000 ohms, ±10%, 2 W Pan Part RVA503AQ-2J	AC JU-5031	2		
R23		Resistor: fixed, composition 820,000 ohms, 1/2 W Pan Part RC20BX824J	AC EB-8245	1		
R24 A, B		Resistor: variable, composition linear, dual 50,000 ohms, 5 megohms, ±20%, 2 W Pan Part RVB503BQ-2J	AC JJU-5032/5052	1		
R25		Resistor: fixed, composition 3,300 ohms, ±5%, 1 W Pan Part RC32BX332J	AC GB-3325	1		
R26		Resistor: fixed, composition 20,000 ohms, ±5%, 1/2 W Pan Part RC20BX203J	AC EB-2035	2		

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
R27		Resistor: fixed, composition 100,000 ohms, ±5%, 1 W Pan Part RC32BX104J	AC GB-1045	5		
R28		Resistor: fixed, composition 470,000 ohms, ±5%, 1/2 W Pan Part RC20BX474J	AC EB-4745	2		
R29		Resistor: fixed, composition 15,000 ohms, ±5%, 1 W Pan Part RC32BX153J	AC GB-1535	2		
R30		Resistor: fixed, composition factory adjust, nominal value** 10,000 ohms, ±5%, 1 W Pan Part RC32BX103J	AC GB-1035	1		
R31		Resistor: fixed, composition 240,000 ohms, ±5%, 1/2 W Pan Part RC20BX244J	AC EB-2445	2		
R32		Resistor: variable, composition linear 2 megohms, ±20%, 2 W Pan Part RVA20BQ-2J	AC JU-2052	1		
R33		Resistor: variable, composition linear 100,000 ohms, ±10%, 2 W Pan Part RVA104AQ-2J	AC JU-1041	2		
R34		Resistor: fixed, composition 5.6 megohms, ±5%, 1/2 W Pan Part RC20BX565J	AC EB-5655	1		
R35		Resistor: variable, composition linear 500,000 ohms, ±10%, 2 W Pan Part RVA504AQ-2J	AC JU-5041			

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
R36		Resistor: fixed, composition 100,000 ohms, ±5%, 1 W Pan Part RC32BX104J	AC GB-1045			
R37		Resistor: fixed, composition 220,000 ohms, ±5%, 1/2 W Pan Part RC20BX224J	AC EB-2245			
R38		Resistor: fixed, composition 220,000 ohms, ±5%, 1/2 W Pan Part RC20BX224J	AC EB-2245			
R39		Resistor: fixed, composition 75,000 ohms, ±5%, 2 W Pan Part RC42BX753J	AC HB-7535	1		
R40		Resistor: variable, composition linear 5,000 ohms, ±10%, 2 W Pan Part RVA502AQ-2J	AC JU-5021	2		
R41		Resistor: fixed, composition 2.2 megohms, ±5%, 1/2 W Pan Part RC20BX225J	AC EB-2255	1		
R42		Resistor: fixed, composition 1,000 ohms, ±5%, 1/2 W Pan Part RC20BX102J	AC EB-1025			
R43		Resistor: fixed, composition 10,000 ohms, ±5%, 1/2 W Pan Part RC20BX103J	AC EB-1035	2		
R44		Resistor: fixed, composition 5,600 ohms, ±5%, 1/2 W Pan Part RC20BX562J	AC EB-5625			
R45		Resistor: fixed, composition 1.8 megohms, ±5%, 1/2 W Pan Part RC20BX185J	AC EB-1855	1		

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
R46		Resistor: fixed, composition 180,000 ohms, ±5%, 1/2 W Pan Part RC20BX184J	AC EB-1845	1		
R47		Resistor: fixed, composition 100,000 ohms, ±5%, 1 W Pan Part RC32BX104J	AC GB-1045			
R48		Resistor: fixed, composition 100,000 ohms, ±5%, 1 W Pan Part RC32BX104J	AC GB-1045			
R49		Resistor: fixed, composition 470,000 ohms, ±5%, 1 W Pan Part RC32BX474J	AC GB-4745	2		
R50		Resistor: fixed, composition 470,000 ohms, ±5%, 1 W Pan Part RC32BX474J	AC GB-4745			
R51		Resistor: variable, composition linear 500,000 ohms, 2000 V, 1/2 W Pan Part RVAH504BI-3	AH CM-8339	1		
R52		Resistor: fixed, composition 270,000 ohms, ±5%, 1 W Pan Part 32BX274J	AC GB-2745	1		
R53		Resistor: variable, composition linear 100,000 ohms, 2000 V, 1/2 W Pan Part RVAH104BI-3	AH CM-8340	1		
R54		Resistor: fixed, composition 390,000 ohms, ±5%, 1 W Pan Part RC32BX394J	AC GB-3945	1		

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
R55		Resistor: fixed, composition factory adjust, nominal value** 20,000 ohms, ±5%, 1/2 W Pan Part RC20BX203J	AC EB-2035			
R56		Resistor: fixed, composition 56,000 ohms, ±5%, 1/2 W Pan Part RC20BX563J	AC EB-5635	1		
R57		Resistor: fixed, composition 47,000 ohms, ±5%, 1 W Pan Part RC32BX473J	AC GB-4735	4		
R58		Resistor: fixed, composition 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AC EB-1045			
R59		Resistor: fixed, composition 51,000 ohms, ±5%, 1/2 W Pan Part RC20BX513J	AC EB-5135	1		
R60		Resistor: fixed, composition 220,000 ohms, ±5%, 1/2 W Pan Part RC20BX224J	AC EB-2245			
R61		Resistor: variable, composition linear 5,000 ohms, ±10%, 2 W Pan Part RVA502AQ-2J	AC JU-5021			
R62		Resistor: fixed, composition 10,000 ohms, ±5%, 1/2 W Pan Part RC20BX103J	AC EB-1035			
R63		Resistor: fixed, composition 470,000 ohms, ±5%, 1/2 W Pan Part RC20BX474J	AC EB-4745			
R64		Resistor: fixed, composition 2,200 ohms, ±5%, 1/2 W Pan Part RC20BX222J	AC EB-2225	6		

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
R65		Resistor: fixed, composition 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AC EB- 1045			
R66		Resistor: fixed, composition 150,000 ohms, ±5%, 1/2 W Pan Part RC20BX154J	AC EB- 1545	1		
R67		Resistor: fixed, composition 220,000 ohms, ±5%, 1/2 W Pan Part RC20BX224J	AC EB- 2245			
R68		Resistor: fixed, composition 4,700 ohms, ±5%, 1/2 W Pan Part RC20BX472J	AC EB- 4725	1		
R69		Resistor: fixed, composition factory adjust, nominal value** 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AC EB- 1045			
R70		Resistor: fixed, composition 680,000 ohms, ±5%, 1/2 W Pan Part RC20BX684J	AC EB- 6845	1		
R71		Resistor: fixed, composition factory adjust, nominal value** 2,200 ohms, ±5%, 1/2 W Pan Part RC20BX222J	AC EB- 2225			
R72		Resistor: fixed, composition 2,200 ohms, ±5%, 1/2 W Pan Part RC20BX222J	AC EB- 2225			
R73		Resistor: fixed, composition 220,000 ohms, ±5%, 1/2 W Pan Part RC20BX224J	AC EB- 2245			
R74		Resistor: fixed, composition 33,000 ohms, ±5%, 1/2 W Pan Part RC20BX333J	AC EB- 3335	1		

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
R75		Resistor: variable, wire wound, (includes S12, SPST switch attached) 20 ohms, 2 W Pan Part RVW200BI-1-S1	AG or AS GC-252 or W20+51	1		
R500		Resistor: fixed, composition 51 ohms, ±5%, 1/2 W Pan Part RC20BX510J	AC EB-5105	2		
R501		Resistor: fixed, composition 51 ohms, ±5%, 1/2 W Pan Part RC20BX510J	AC EB-5105			
R502		Resistor: fixed, composition 220 ohms, ±5%, 1/2 W Pan Part RC20BX221J	AC EB-2215	5		
R503		Resistor: fixed, composition 5,600 ohms, ±5%, 1/2 W Pan Part RC20BX562J	AC EB-5625			
R504		Resistor: fixed, composition 62,000 ohms, ±5%, 2 W Pan Part RC42BX623J	AC HB-6235	1		
R505		Resistor: fixed, composition 2,200 ohms, ±5%, 1 W Pan Part RC32BX222J	AC GB-2225	2		
R506		Resistor: fixed, composition 220 ohms, ±5%, 1/2 W Pan Part RC20BX221J	AC EB-2215			
R507		Resistor: variable, composition CCW "B" taper 5,000 ohms, ±10%, 2 W Pan Part RVA502EQ-2J	AC JB-5021	1		

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
R508		Resistor: fixed, composition 47,000 ohms, ±5%, 1 W Pan Part RC32BX473J	AC GB-4735			
R509		Resistor: fixed, composition 47,000 ohms, ±5%, 1 W Pan Part RC32BX473J	AC GB-4735			
R510		Resistor: fixed, composition 2,200 ohms, ±5%, 1 W Pan Part RC32BX222J	AC GB-2225			
R511		Resistor: fixed, composition 1,600 ohms, ±5%, 1/2 W Pan Part RC20BX162J	AC EB-1625	1		
R601		Resistor: fixed, composition 430 ohms, ±5%, 1/2 W Pan Part RC20BX431J	AC EB-4315	3		
R602		Resistor: fixed, composition 220 ohms, ±5%, 1/2 W Pan Part RC20BX221J	AC EB-2215			
R603		Resistor: fixed, composition 430 ohms, ±5%, 1/2 W Pan Part RC20BX431J	AC EB-4315			
R605		Resistor: fixed, composition 430 ohms, ±5%, 1/2 W Pan Part RC20BX431J	AC EB-4315			
R606		Resistor: fixed, composition 220 ohms, ±5%, 1/2 W Pan Part RC20BX221J	AC EB-2215			
R608 A, B		Resistor: variable, composition linear, dual 1 megohm, / 1 megohm, ±20% 2 W Pan Part RVB105/105BQ-2J	AC JJA-1052	1		

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
R609		Resistor: variable, composition linear 1 megohm, ±20%, 2 W Pan Part RVA105BQ-2J	AC JU-1052	1		
R610		Resistor: variable, composition 10,000 ohms, ±10%, 2 W Pan Part RVA103AQ-2J	AC JU-1031	1		
R611		Resistor: fixed, composition 150 ohms, ±5%, 1/2 W Pan Part RC20BX151J	AC EB-1515	2		
R612		Resistor: fixed, composition 100,000 ohms, ±5%, 1 W Pan Part RC32BX104J	AC GB-1045			
R613		Resistor: fixed, composition 75,000 ohms, ±5%, 1 W Pan Part RC32BX753J	AC GB-7535	1		
R614		Resistor: fixed, composition 2,200 ohms, ±5%, 1/2 W Pan Part RC20BX222J	AC EB-2225			
R615		Resistor: fixed, composition 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AC EB-1045			
R616		Resistor: fixed, composition 100 ohms, ±5%, 1/2 W Pan Part RC20BX101J	AC EB-1015			
R617		Resistor: fixed, composition 100 ohms, ±5%, 1/2 W Pan Part RC20BX101J	AC EB-1015			
R618		Resistor: variable, composition linear 50,000 ohms, ±10%, 2 W Pan Part RVA503AQ-2J	AC JU-5031			

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
R619		Resistor: fixed, composition 15,000 ohms, ±5%, 1 W Pan Part RC32BX153J	AC GB- 1535			
R620		Resistor: fixed, composition 33,000 ohms, ±5%, 1 W Pan Part RC32BX333J	AC GB- 3335	1		
R621		Resistor: fixed, composition 5,600 ohms, ±5%, 1 W Pan Part RC32BX562J	AC GB- 5625	2		
R622		Resistor: fixed, composition 68,000 ohms, ±5%, 1/2 W Pan Part RC20BX683J	AC EB- 6835	1		
R623		Resistor: fixed, composition 5,600 ohms, ±5%, 1 W Pan Part RC32BX562J	AC GB- 5625			
R624		Resistor: fixed, composition 100,000 ohms, ±10%, 2 W Pan Part RVA104AQ-2J	AC JU- 1041			
R625		Resistor: fixed, composition 220,000 ohms, ±5%, 1/2 W Pan Part RC20BX224J	AC EB- 2245			
R626		Resistor: fixed, composition 2,200 ohms, ±5%, 1/2 W Pan Part RC20BX222J	AC EB- 2225			
R627		Resistor: fixed, composition 22,000 ohms, ±5%, 1 W Pan Part RC32BX223J	AC GB- 2235	1		
R628		Resistor: fixed, composition 2,200 ohms, ±5%, 1/2 W Pan Part RC20BX222J	AC EB- 2225			

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
R629		Resistor: fixed, composition 150 ohms, ±5%, 1/2 W Pan Part RC20BX151J	AC EB-1515			
R630		Resistor: variable, composition 3,000 ohms, ±10%, 2 W Pan Part RVA302AQ-2J	AC JU-3021	1		
R631		Resistor: fixed, composition 220 ohms, ±5%, 1/2 W Pan Part RC20BX221J	AC EB-2215			
R632		Resistor: variable, composition linear 500 ohms, ±10%, 2 W Pan Part RVA501AQ-2J	AC JU-5011	1		
R633		Resistor: fixed, composition 220,000 ohms, ±5%, 1/2 W Pan Part RC20BX224J	AC EB-2245			
R634		Resistor: fixed, wire wound axial leads 1 ohm, 1/2 W Pan Part RCW20AX010K	AS BW-1/2	2		
R635		Resistor: fixed, wire wound axial leads 1 ohm, 1/2 W Pan Part RCW20AX010K	AS BW-1/2			
R636		Resistor: fixed, wire wound tab tubular, radial leads 5,000 ohms, ±10%, 10 W Pan Part RW10X502R-6	BC FRL-10	1		
R637		Resistor: fixed, composition 47,000 ohms, ±5%, 1 W Pan Part RC32BX473J	AC GB-4735			

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
R638		Resistor: fixed, composition factory adjust, nominal value** 4,300 ohms, ±5%, 1/2 W Pan Part RC20BX432J	AC EB-4325	1		
R639		Resistor: fixed, composition 150,000 ohms, ±5%, 1 W Pan Part RC32BX154J	AC GB-1545	1		
R640		Resistor: fixed, composition factory adjust, nominal value 75 ohms, ±5%, 1/2 W Pan Part RC20BX750J	AC EB-7505	2		
R641		Resistor: fixed, composition factory adjust, nominal value 75 ohms, ±5%, 1/2 W Pan Part RC20BX750J	AC EB-7505			
SW10 A, B, C		Rotary switch: 3 pole, 3 pos. 1 deck ceramic Pan Part S2014	AF 2507	2		
SW11 A, B, C		Rotary switch: 3 pole, 3 pos. 1 deck ceramic Pan Part S2014	AF 2507			
SW12		See R75				
SW13		Rotary switch: 1 pole, 3 pos. 1 wafer bakelite Pan Part S1026	AF 1461	1		
T3		Transformer: voltage regulating Input 95-130 VAC, 60 C, 1 ph, output 118 VAC Pan Part T3016-1	AY T3016-1	1		

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
T101		Transformer: R.F. 5.25 MC, ±.5 MC Pan Part ZN-8250	AY ZN- 8250	1		
T102		Transformer: R.F. 5.25 MC, ±.5 MC Pan Part ZN-8251	AY ZN- 8251	1		
V1		Electron Tube: 6BE6 Pan Part 6BE6	AZ 6BE6	2		
V2		Electron Tube: 6BH6 Pan Part 6BH6	AZ 6BH6	2		
V3		Electron Tube: 6BE6 Pan Part 6BE6	AZ 6BE6			
V4		Electron Tube: 6AH6 Pan Part 6AH6	AZ 6AH6	1		
V11		Electron Tube: 12AT7 Pan Part 12AT7	AZ 12AT7	3		
V12		Electron Tube: 6BH6 Pan Part 6BH6	AZ 6BH6			
V13		Electron Tube: 6AU6 Pan Part 6AU6	AZ 6AU6	1		
V14		Electron Tube: 12AU7 Pan Part 12AU7	AZ 12AU7	3		
V15		Electron Tube: 12AU7 Pan Part 12AU7	AZ 12AU7			
V16		Electron Tube: 12AT7 Pan Part 12AT7	AZ 12AT7			
V17		Electron Tube: 6U8 Pan Part 6U8	AZ 6U8	2		

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
V18		Electron Tube: 12AU7 Pan Part 12AU7	AZ 12AU7			
V19		Electron Tube: Cathode-ray, 5UP7 Pan Part 5UP7	AZ 5UP7	1		
V20		Electron Tube: OC3 Pan Part OC3	AZ OC3	1		
V21		Electron Tube: 6U8 Pan Part 6U8	AZ 6U8			
V23		Electron Tube: 12AT7 Pan Part 12AT7	AZ 12AT7			
XI1		Pilot light holder assembly Pan Part B-1014-CH	AK 81410-622	1		
XI2		Pilot light holder, miniature bayonet Pan Part B-2033	AK 7-06	1		
XI10		Neon Glow Lamp Socket Pan Part B-2027-M	AY B2027-M	1		
XV1		Socket: 7 pin miniature Pan Part X-1105	AL 305-BC	6		
XV2		Socket: 7 pin miniature Pan Part X-1105	AL 305-BC			
XV3		Socket: 7 pin miniature Pan Part X-1105	AL 305-BC			

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
XV4		Socket: 7 pin miniature Pan Part X-1105	AL 305-BC			
XV11		Socket: 9 pin miniature Pan Part X-1100	AL 371-BC	8		
XV12		Socket: 7 pin miniature Pan Part X-1105	AL 305-BC			
XV13		Socket: 7 pin miniature Pan Part X-1105	AL 305-BC			
XV14		Socket: 9 pin miniature Pan Part X-1100	AL 371-BC			
XV15		Socket: 9 pin miniature Pan Part X-1100	AL 371-BC			
XV16		Socket: 9 pin miniature Pan Part X-1100	AL 371-BC			
XV17		Socket: 9 pin miniature Pan Part X-1100	AL 371-BC			
XV18		Socket: 9 pin miniature Pan Part X-1100	AL 371-BC			
XV19		Socket: CRT Assembly Pan Part X-1084	AB 212-FTS	1		

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
XV20		Socket: Octal Pan Part X-1020	BG 115- 001- 1NS	1		
XV21		Socket: 9 pin miniature Pan Part X-1100	AL 371- BC			
XV23		Socket: 9 pin miniature Pan Part X-1100	AL 371- BC			
XY1		Socket: crystal Pan Part X-1089A	AV 33102	2		
XY2		Socket: crystal Pan Part X-1089A	AV 33102			
Y1		Crystal: 1.5 Megacycle Pan Part 2Y3003A	AQ 2Y30 03A	2		
Y2		Crystal: 1.5 megacycle Pan Part 2Y3003A	AQ 2Y30 03A			
Z101		Transformer: R.F. Oscillator Coil & R.F. Choke 6 - 7 MC Pan Part ZN-8245	AY ZN- 8245	1		
Z102		Transformer: R.F. 1.5 Megacycle Pan Part ZN-8326	AY ZN- 8326	1		
Z103		Transformer: R.F. Center Tapped 1.5 Megacycle Pan Part ZN-8247	AY ZN- 8247	1		

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
Z104		Transformer: R.F. 1.5 Megacycle Pan Part ZN-8248	AY ZN- 8248	1		
Z105		Transformer: R.F. 1.5 Megacycle Pan Part ZN-8249	AY ZN- 8249	1		

Power Supply

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
C1 A, B		Capacitor: electrolytic Plug-in, Octal Base 2 x 20 uf, 450 V Pan Part CE52X200R-1	BD PE-2755	1		
C2 A, B		Capacitor: fixed, paper oil-filled rectangular 2 x .25 uf, 2000 V Pan Part CP70D6XJ254X-5	AO CGF-7071	2		
C3 A, B		Capacitor: fixed, paper oil-filled rectangular 2 x .25 uf, 2000 V Pan Part CP20D6XJ254X-5	AO CGF-7071			
C4		Capacitor: fixed, ceramic disc .01 uf, 500 V Pan Part CC-2003-17	AC 36-103W	2		
C5		Capacitor: fixed, ceramic disc .01 uf, 500 V Pan Part CC-2003-17	AC 36-103W			
CR1		Rectifier, selenium: Cartridge Type 5 MA, 200 V Pan Part CR-2005	AT V100 HF	1		
F1		Fuse, Cartridge, Instantaneous Type 2 amp Pan Part F-1003	AE AGC2	2		
F2		Fuse, Cartridge, Instantaneous Type 2 amp Pan Part F-1003	AE AGC2			

Power Supply (continued)

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
J1		Receptacle, twistlock, male 3-wire flush midget motor base Pan Part J-1002	AP 7486	1		
J2		Box mounting receptacle, female 14-contact - solid shell Pan Part J-2008	AD MS-3102A-28-2S	1		
L1		Filter Reactor, 8 Hy Pan Part L-2015	AN 1F231	2		
L2		Filter Reactor, 8 Hy Pan Part L-2015	AN 1F231			
PJ2		Plug, straight, male, 14-contact, split shell Pan Part P-2035	AD MS-3106B-28-2P	1		
PJ10		Plug-straight, female, 14-contact, split shell Pan Part P-2034	AD MS-3106B-28-2S			
R1		Resistor: fixed, composition 150,000 ohms, ±5%, 1 W Pan Part RC32BX154J	AC GB-1545	1		
R2		Resistor: fixed, composition 24,000 ohms, ±5%, 1 W Pan Part RC32BX243J	AC GB-2435	1		
R3		Resistor: fixed, composition 10 megohms, ±5%, 2 W Pan Part RC42BX106J	AC HB-1065	2		

Power Supply (continued)

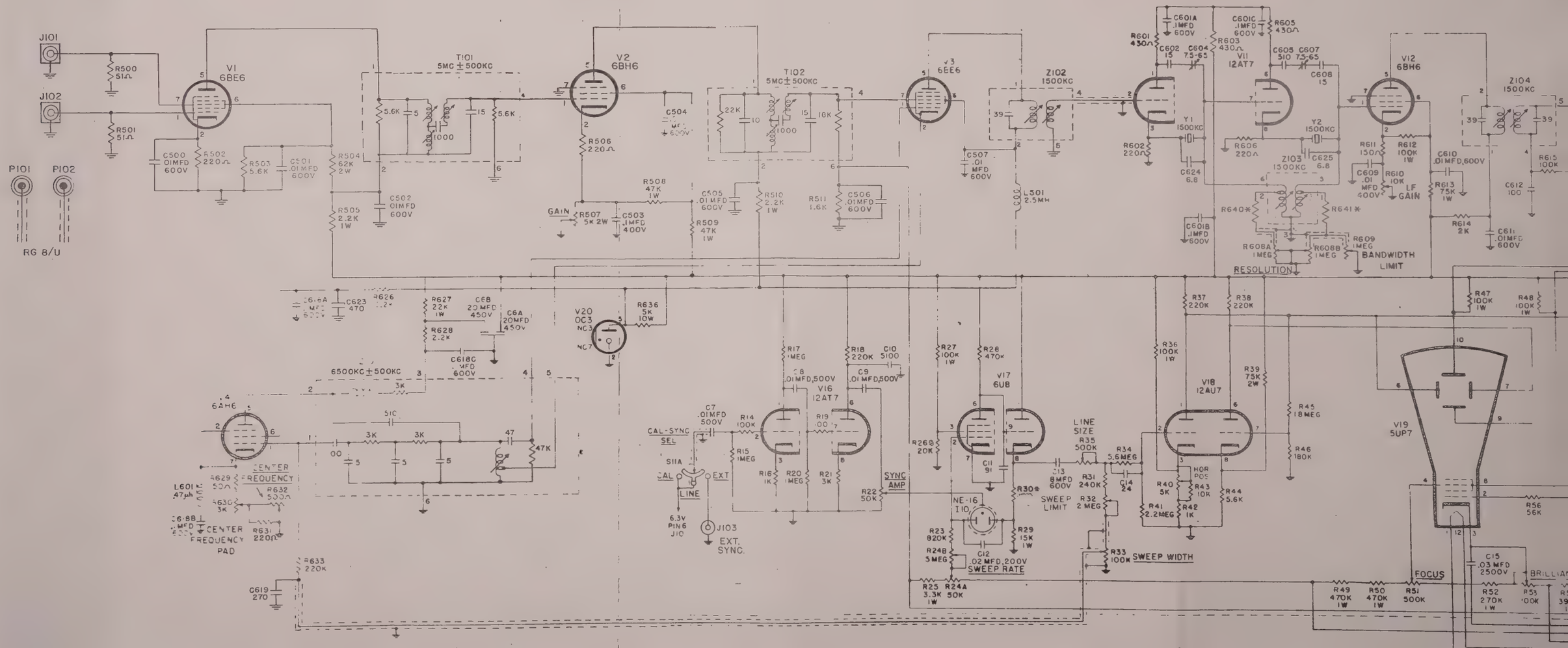
CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
R4		Resistor: fixed, composition 10 megohms, ±5%, 2 W Pan Part RC42BX106J	AC HB- 1065			
T1		Transformer: low voltage Pan Part T-3015	AY T3015	1		
T2		Transformer: high voltage Pan Part T3-9875A	AY T3- 9875A	1		
V101		Electron Tube: 5V4G Pan Part 5V4G	AZ 5V4G	1		
XC1 A, B		Socket: octal, ceramic Pan Part X-1020	BG 115001 -1NS	2		
XF-1		Fuse Holder: extractor type Pan Part F-2010	BI 342003	2		
XF-2		Fuse Holder: extractor type Pan Part F-2010	BI 342003			
XV101		Socket: octal Pan Part X-1020	BG 115001 -1NS			
		The following additional parts are used with a 5ADP7 crt.				
C6 A, B		Capacitor: fixed, paper 2 x .25 uf, 2000 WV Pan Part CP70D6XJ254X-5	AO CGF- 7071	1		
CR2		Rectifier: Selenium 5 MA, 2000 V Pan Part CR-2005	AT V 100 HF	1		

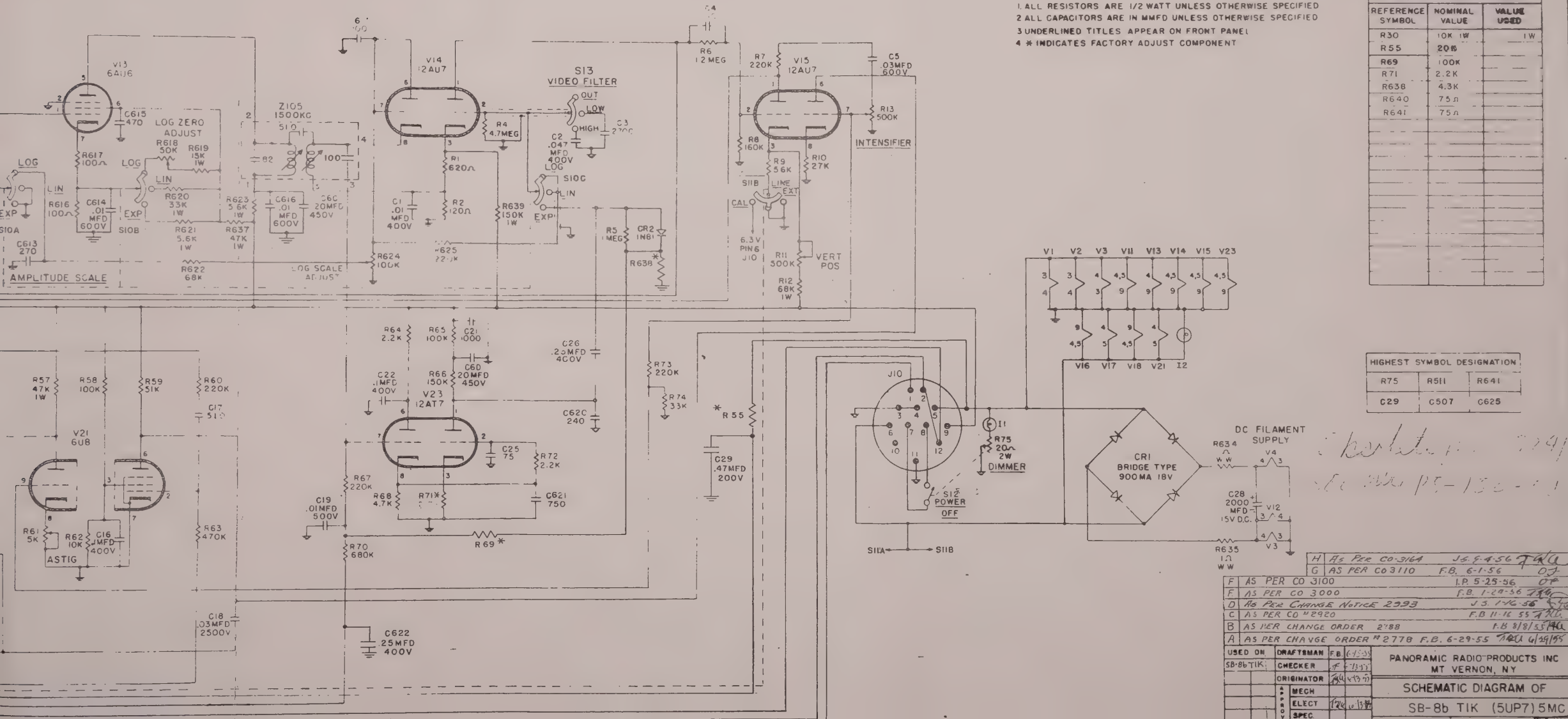
Power Supply (continued)

CIRCUIT REF SYMBOL	STOCK NO	DESCRIPTION	MFR & MFRS NO	QTY IN SET	QTY 3 MO OPN	UNIT PRICE
I3		Pilot Lamp: edge-lighting Pan Part B-2042-W	AY B2042-W	4		
I4		Pilot Lamp: edge-lightinh Pan Part B-2042-W	AY B2042-W			
I5		Pilot Lamp: edge-lighting Pan Part B-2042-W	AY B2042-W			
I6		Pilot Lamp: edge-lighting Pan Part B-2042-W	AY B2042-W			
R5		Resistor: fixed, composition 10 meg., ±5%, 2 W Pan Part RC42BX106J	AC HB-1065	2		
R6		Resistor: fixed, composition 10 meg., ±5%, 2 W Pan Part RC42BX106J	AC HB-1065			
R75		Resistor: variable, wire-wound (includes S/2, SPST switch attached) 6 ohms, 2 W Pan Part RVW060BI-1-S1	AG GC-252	1		

MANUFACTURERS CODE LIST

AA	Aerovox Corporation
AB	Alden Products Company
AC	Allen-Bradley Company
AD	Amphenol Electronics Corporation
AE	Bussman Fuse Division of McGraw-Edison Company
AF	Centralab Division of Globe Union, Incorporated
AG	Chicago Telephone Supply Company
AH	Clarostat Manufacturing Company, Incorporated
AI	Cornell Dubilier Electric Corporation
AJ	Cornish Wire Company
AK	Dialight Corporation
AL	Elco Corporation
AM	Electro-Motive Manufacturing Company
AN	General Transformer Company
AO	Gudeman Company
AP	Harvey Hubbel, Incorporated
AQ	Hupp Electronics Company Division of Hupp Corporation
AR	Indistrial Condenser Corporation
AS	International Resistance Company
AT	International Rectifier Corporation
AU	J. F. D. Manufacturing Company, Incorporated
AV	James Millen Manufacturing Company, Incorporated
AW	J. W. Miller Company
AX	Oak Manufacturing Company
AY	Panoramic Radio Products, Incorporated
AZ	Any EIA Manufacturer
BA	Radio Receptor Company, Incorporated
BB	Reeves Hoffman Corporation
BC	Sangamo Electric Company
BD	Sprague Products Company
BE	Stackpole Carbon Company
BF	Tru-Ohm Products Division of Model Engineering and Manufacturing Incorporated
BG	United-Carr Fastener Company
BH	Sprague Electric Company
BI	Littelfuse, Incorporated
BJ	Cinch-Jones


J101
J102
R500 51Ω
R501 51Ω
V1 6BE6
T101 5MC ± 500KC
V2 6BH6
T102 5MC ± 500KC
V3 6BE6
Z102 1500KC
C601A .1MFD 600V
C601C .1MFD 600V
R601 430Ω
R603 430Ω
R605 430Ω
C602 15
C604 7.5-65
C605 C607 510 7.5-65
C608 15
V11 12AT7
Y1 1500KC
Y2 1500KC
R602 220Ω
R606 220Ω
Z103 1500KC
C625 6.8
C624 6.8
V12 6BH6
Z104 1500KC
R611 150Ω
R612 100K 1W
C609 .01 MFD 400V
R610 10K LF GAIN
C610 .01MFD,600V
R613 75K 1W
R615 100K
C612 100
R614 2K
C611 .01MFD 600V
C601B .1MFD 600V
R640*
R641*
R608A 1MEG
R608B 1MEG
R609 1MEG BANDWIDTH LIMIT
RESOLUTION
P101
P102
RG 8/U
C500 .01MFD 600V
R502 220Ω
R503 5.6K
C501 .01MFD 600V
R504 62K 2W
R505 2.2K 1W
C502 .01MFD 600V
5.6K
15
5.6K
1000
R506 220Ω
C504 .1MFD 600V
22K
10
15
16K
1000
R508 47K 1W
C505 .01MFD 600V
R510 2.2K 1W
R511 1.6K
C506 .01MFD 600V
R509 47K 1W
GAIN
R507 5K 2W
C503 .1MFD 400V
C507 .01 MFD 600V
L301 2.5MH
C623 470
R626
R627 22K 1W
C6B 20 MFD 450V
C6A 20MFD 450V
R628 2.2K
C6180 .1MFD 600V
V20 OC3 NC3 NC7
R636 5K 10W
6500KC ± 500KC
3K
V4 6AH6
51C
3K
3K
47
47K
00
CENTER FREQUENCY
R629 50Ω
R632 500Ω
R630 3K
L601 .47μh
C6B8 .1MFD 600V
CENTER FREQUENCY PAD
R631 220Ω
R633 220K
C619 270
R17 1MEG
R18 220K
C10 5100
C8 .01MFD,500V
C9 .01MFD,500V
V16 12AT7
C7 .01MFD 500V
R14 100K
R15 1MEG
R19 .00
R16 1K
R20 1MEG
R21 3K
CAL-SYNC SEL
SIIA
CAL
EXT
LINE
6.3V PIN6 J10
J103 EXT. SYNC.
SYNC AMP
R22 50K
R27 100K 1W
R28 470K
V17 6U8
R26 20K
C11 91
R30
NE-16 110
C12 .02 MFD,200V SWEEP RATE
R23 820K
R24B 5MEG
R25 3.3K 1W
R24A 50K
LINE SIZE
R35 500K
R34 5.6MEG
C13 .1MFD 600V
SWEEP LIMIT
R31 240K
C14 24
R32 2 MEG
R33 100K SWEEP WIDTH
R36 100K 1W
R37 220K
R38 220K
V18 12AU7
R39 75K 2W
R45 1MEG
R46 180K
R40 5K
HOR POS
R43 10K
R41 2.2MEG
R42 1K
R44 5.6K
R47 100K 1W
R48 100K 1W
V19 5UP7
R56 56K
C15 .03 MFD 2500V
FOCUS
BRILLIA
R49 470K 1W
R50 470K 1W
R51 500K
R52 270K 1W
R53 100K



1. ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED
2. ALL CAPACITORS ARE IN MMFD UNLESS OTHERWISE SPECIFIED
3. UNDERLINED TITLES APPEAR ON FRONT PANEL
4. * INDICATES FACTORY ADJUST COMPONENT

FACTORY ADJUST COMPONENTS		
REFERENCE SYMBOL	NOMINAL VALUE	VALUE USED
R30	10K 1W	1W
R55	20Ω	
R69	100K	
R71	2.2K	
R638	4.3K	
R640	75Ω	
R641	75Ω	

HIGHEST SYMBOL DESIGNATION		
R75	R511	R641
C29	C507	C625

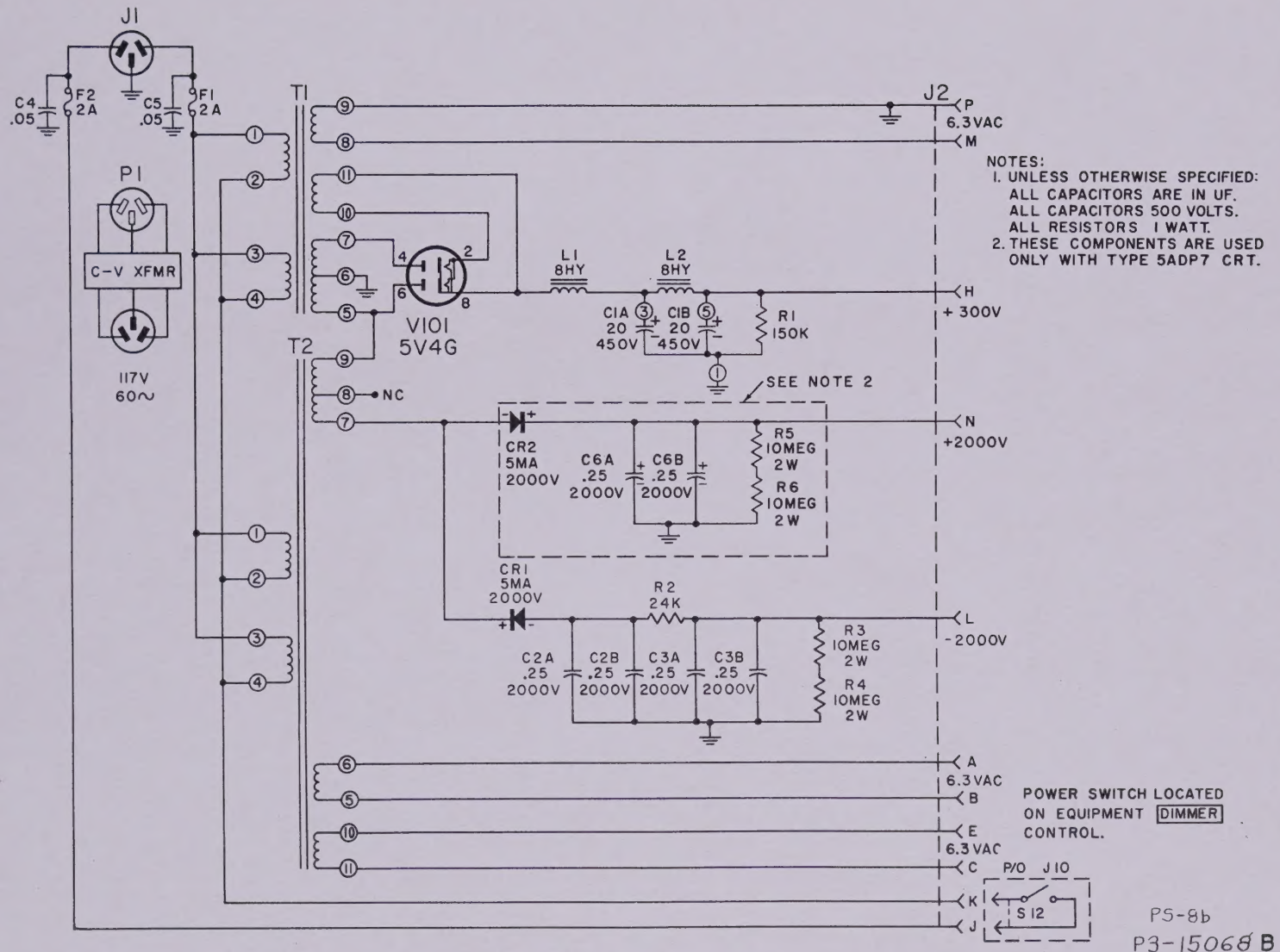
H	AS PER CO-3164	J.S. 4-5-56	TAG
G	AS PER CO 3110	F.B. 6-1-56	OF
F	AS PER CO 3100	I.P. 5-25-56	OF
F	AS PER CO 3000	F.B. 1-24-56	TAG
D	AS PER CHANGE NOTICE 2933	J.S. 1-16-56	TAG
C	AS PER CO #2920	F.B. 11-16-55	TAG
B	AS PER CHANGE ORDER 2788	F.B. 8/8/55	TAG
A	AS PER CHANGE ORDER #2778	F.B. 6-29-55	TAG 6/29/55

USED ON			
SB-8b TIK	DRAFTSMAN	F.B.	6-1-55
	CHECKER		6-13-55
	ORIGINATOR		6-13-55
	APPROV MECH		
	APPROV ELECT		6-13-55
	APPROV SPEC		

PANORAMIC RADIO PRODUCTS INC
MT VERNON, NY

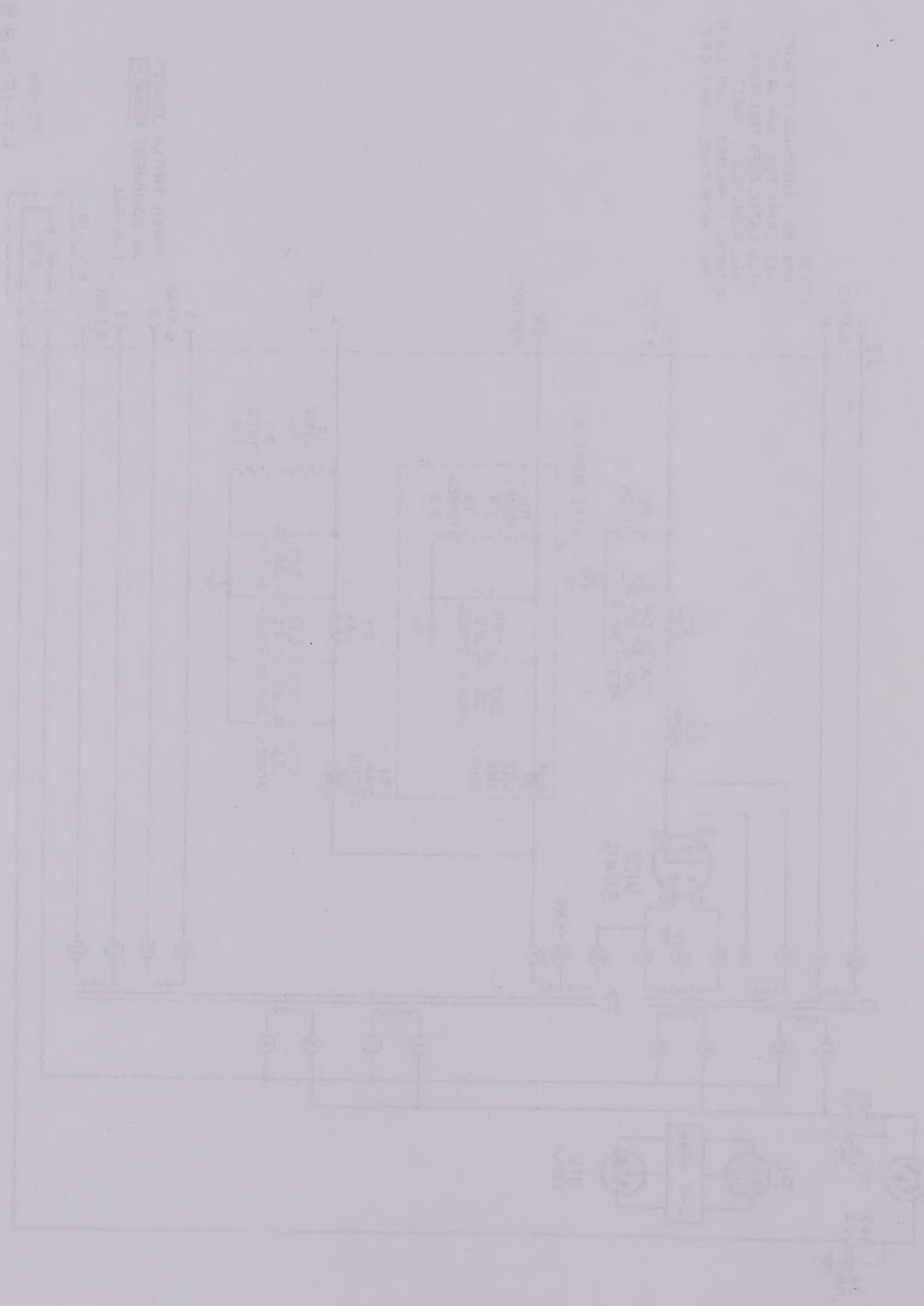
SCHEMATIC DIAGRAM OF

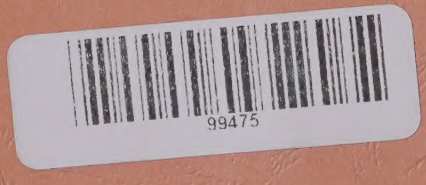
SB-8b TIK (5UP7) 5MC



PS-8b

P3-15068 B




99475